SCIENCE.

FRIDAY, AUGUST 10, 1883.

## *THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.*

Next week will see the annual meeting of the American association for the advancement of science. Although the pendulum-like swing of its migration takes it this year to the westernmost point of its meetings, — to a flourishing city that was founded since the association began its good work, — there is a promise of a larger and more successful meeting than has been its lot to have for several years. Though its roots go down slowly, there is good reason to believe that this society is at last taking firm hold in our hard and stubborn American society, which long seemed to deny it a fair chance of growth. It was, in fact, a much more serious task than it at first seemed, to create in America an association on the basis of that which grew so rapidly and so well in the British mother-country. The success of the British association was due in the main to the fact that the distances the members had to travel were small, so that a large part of the working members could be relied on to attend from year to year in a regular way; thus giving a continuity to its intellectual life that has been denied to our association. Then in Britain, and the sister kingdom of Ireland, there are a score or more places where there exists a strong local life, a pride in the reputation of locality, and a mass of inherited wealth liberalized by long tradition that could easily be brought to the support of such meetings. Still more effective was the support which a centralized government could give, and the money that came easily at the call of the scientific leaders who made themselves responsible for the work the association undertook. All these advantages were denied to the American association in its earlier years. In the most of its meeting-places there was little to uphold its work; it toiled as a missionary enterprise — patiently, but with scanty reward. Its recent gain in public esteem has been in part the result of its own good and devoted work, but in larger measure it is the result of the exceedingly rapid change in the condition of American city life. The frontier spirit in our American towns, the greed for immediate ends, is passing away. Few towns of twenty thousand people but have their leisured class, or are without some well-shaped ambition for a good name among men of learning. Although the association was, in its earlier years, somewhat before its time, our life is fast growing up to be a support for such work as it seeks to do. Every friend of learning will welcome the assurance of strong life that these changes give to the association, and will look forward to its future with confidence in its work.

Experience that we may gain from the results of the association and of its kindred societies in the mother-country and on the continent shows us clearly what this work should be. First of all is the good-fellowship, the solidarity that is bred by bringing together in one assembly people who have no other chance to get the light from each others' eyes or the spirit from their fellow-workers' tongues. However we may value the material gain of fact, there can be no doubt that this is the precious thing which the association can give to American science. Our workers are necessarily scattered by the geographical immensities of their land; the teaching that the nature about their homes gives them is, from the conformity of conditions in almost all neighborhoods, limited and incomplete. More than any other men of science, they need a season of contact with those trained amidst other conditions. Some things grow well in a corner, but natural science is not of them. Whoever has brought to a meeting of the American association memories of similar gatherings in

Europe must have felt that this social element in our society left much to be desired. The writer recalls the time when he attended the Swiss association at Rheinfelden in one year, and the American the next, in a rather gloomy manufacturing town. At the Swiss meeting all the members dined together in a garden on the banks of the Rhine, after the morning session had been gone through with all due solemnity. There was, be it confessed, much wine, but so much wit and wisdom, withal, that the very prophets of teetotalism would have been moved to sympathy. In the social fire that only a table can provoke, in ordinary mortals at least, these diverse folk, separated by race and tongue, were fused into unity and brotherhood.

Making all due allowance for our inherited need of taking diversions a little sadly, it does seem that we might heighten the social element in our meetings. Even the most august British societies descend to tea after the meetings, and find their profit in it from the closer and more familiar life that it gives. Although we use it little, our American folk have an unequalled capacity for after-dinner talking; half our folk have the *toast-master* in them: so we need not fear that such gatherings would be dull.

Coming to the apparently more scientific aspects of its labors, maintaining the while that the science of good-fellowship is the prince of all learning, let us consider some other parts of the association's work. The experience of the British association seems to show that they succeed in avoiding the extreme haphazard nature of the discussions which mark our own association. This is in part due to the continuity of attendance of its leading members, but it seems as if a part of its gain in this direction had been due to the fashion of having special committees charged with the study of large questions of public interest. Coming to the association with their minds full of the results of especially designated inquiries, the committee-men have been able to give an element of direction to its discussions that have often made them admirably deliberative, and exceedingly profitable to all who heard them. If our association would take care to provide committees with important inquiries, and could furnish them with the money necessary for the securing of information when such aid was required, we might have each year a solid body of matter which would insure a profit to all who might attend. Giving these reports and their discussion the precedence in the meetings, the vagarists, the lost tribes of circle-squarers, law-finders, and others who wander in the wilderness, would not be able to render the sessions unprofitable to students, as they not unfrequently do, even in these latter days of the association.

There is yet another chance of bettering the association-work. One of its highest aims is to foster the spirit of philosophical inquiry among the people with whom its lot is cast from year to year. Something, but not much, may be accomplished by the mere presence of notable men, and their wise words. Yet the odor of the sanctuary is but fleeting: it is not in the least a monumental thing. The ordinary citizens or the school-children mark the fact that for a week some hall puts on a beehive look; the papers have reports, mostly incomprehensible; and then the matter is forgotten. There seem to be several ways of increasing the local effects of these meetings. First, there should be a careful preliminary study of the scientific problems that the neighborhood affords, a sufficient presentation of those that are understood, and a suggestion of inquiries thereafter to be made. This should be printed, and would serve for a local guide for the use of the association, and as an incentive to local workers. Then, if it seems well, the association should offer some small prize to those students on the ground who would carry farther the inquiries that this report has shown to be desirable. If the conditions permit, the association would do well to see that some local society, such as the field-clubs that were recently advocated in these columns, should be created, to remain as a successor to its objects and a fosterer of its work. In the inspiration that these meetings generally

arouse, such a society might even secure a small fund for its maintenance.

Last, and if such a work be possible, best of all, the association might, through a proper committee, do much to promote science-teaching in the schools of the cities where it each year bides. Every meeting of the association has among its attendants those who have the much-needed skill in the matter of teaching science. There is hardly a public school in the land where there is not a crying need of such help as could best be given at such times. There should be a committee, or even perhaps a section of the association, devoted to the promotion of sound teaching in natural science; for the gravest danger before this branch of learning is to be found in the radical imperfection of the methods of science-teaching in use in our schools. These suggestions may seem to lay heavy burdens of advice on the association, but none of them seem beyond the promise of its strength.

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## *RECENT EXPLORATIONS IN THE REGION OF THE GULF-STREAM OFF THE EASTERN COAST OF THE UNITED STATES BY THE U. S. FISH-COMMISSION.*[1]

### 4. Nature and origin of the deposits.

ALONG part of the Gulf-Stream slope examined by us, the bottom, in 65 to 150 fathoms, 80 to 110 miles from the shore, is composed mainly of very fine siliceous sand, mixed with a little clay, and containing always a considerable percentage of the shells of Foraminifera and other calcareous organisms, and frequently spherical, rod-like, and stellate sand-covered rhizopods, sometimes in large quantities. Among the Foraminifera, Globigerina is abundant; but many other forms occur, some of them of large size and elegant in form. Grains of green sand (glauconite) were frequently met with, but were not abundant. Large quantities of the tubes of annelids frequently occur. Some of these are made of cemented mud, fine sand, or of gravel; others, of parchment-like secretions. On the inshore plateau, and also in the deeper localities on the slope, there is usually more or less genuine mud or clay; but this is generally mixed with considerable fine sand, even in 300 to 600 fathoms. The sand, however, is often so fine as to resemble mud, and is frequently so reported when the preliminary soundings are made. In several localities the bottom was so 'hard,' in 65 to 125 fathoms, that the bulk of the material brought up consisted of sponges, worm-tubes, shells, etc., with some gravel, but with neither mud nor fine sand. Such bottoms were very rich in animal life. In many instances, even in our deeper dredgings (about 700 fathoms), and throughout the belt examined, we have taken numerous pebbles, and small, rounded bowlders of all sizes, up to several pounds in weight, consisting of granite, sienite, mica schist, etc. These are abundant in some localities, and covered with Actiniae, etc. Probably, while frozen into the shore-ice in winter and spring, they have been recently floated out from our shores and rivers, and dropped in this region, where the ice melts rapidly under the influence of the warmer Gulf-Stream water. Probably much of the sand, especially the coarser portions, may have been transported by the same agency.

[1] Continued from No. 19.

Another way, generally overlooked, in which fine beach-sand can be carried long distances out to sea, is in consequence of its floating on the surface of the water after it has been exposed to the air, and dried on the beaches. The rising tide carries off a considerable amount of dry sand, floating in this way. In our fine towing-nets we often take more or less fine siliceous sand which is evidently floating on the surface, even at considerable distances from the shore. The vast sand-beaches, extending from Long Island to Florida, afford an inexhaustible supply of this fine sand.

The prevalence of fine sand along the Gulf-Stream slope in this region, and the remarkable scarcity of fine mud or clay deposits, indicate that there is here, at the bottom, a current usually sufficient to prevent, for the most part, the deposition of fine argillaceous sediments over the upper portion of the slope, in 65 to 150 fathoms. Such materials are probably carried along, for the greater part, till they eventually sink to greater depths, nearer the base of the slope, or beyond in the ocean-basin itself, where the currents are less active. Doubtless, there are also belts along which the northern current meets and opposes the Gulf Stream, causing less motion, and favoring the deposition of fine sediments. It is probable that motion of the water along the upper part of the slope may also be caused by tidal currents, which would modify the north-eastern flow of the Gulf Stream, both in direction and velocity. Currents produced by protracted storms might have the same effect. In depths

greater than 200 fathoms on the outer slope, and in 25 to 60 fathoms on the inshore plateau, there is doubtless a slow, cold current to the south-west. It is not probable that these bottom-currents are strong enough to move even the fine sand after it has once actually reached the bottom; nor is it strong enough to prevent the general deposition of oceanic foraminifera, pteropods, etc.

The existence of actual currents in this region, sufficiently powerful to directly effect an erosion of the bottom, is hardly supposable. Such a result may be effected, however, in consequence of the peculiar habits of certain fishes and crustacea that abound on these bottoms. Many fishes, like the 'hake' (Phycis), of which three species are common here, have the habit of rooting in the mud for their food, which consists largely of Annelida and other mud-burrowing creatures. Other fishes, those with sharp tails especially, burrow actively into the mud or sand, tail first; and in all probability Macrurus, abundant on these slopes, has this habit. Several burrowing species of true eels and eel-like fishes are very abundant on these bottoms. Many of the crabs and other crustacea are active burrowers. Such creatures, by continually stirring up the bottom sediments, give the currents a chance to carry away the finer and lighter materials, leaving the coarser behind.

In many localities there are great quantities of dead shells, both broken and entire. A small proportion of the unbroken bivalves have been drilled by carnivorous gastropods, but there are large numbers that show no such injury. These have, for the most part, undoubtedly served as food for the star-fishes and large Actiniae, abundant on these grounds, and from which I have often taken many kinds of entire shells, including delicate pteropods. Many fishes, like the cod, haddock, hake, flounders, etc., have the habit of swallowing shells entire, and, after digesting the contents, they disgorge the uninjured shells. Such fishes abound here. Species of Octopus are also known to feed upon bivalves without breaking them, and O. Bairdii is common in these depths. The broken shells have probably been destroyed, in large part, by the large crabs and other crustaceans having claws strong enough to crack the shells. The large species of Cancer and Geryon, and the larger Paguri, abundant in this region, have strength sufficient to break most of the bivalve shells. Many fishes that feed on mollusca also crush the shells before swallowing them. Both fishes and crabs have, doubtless, thus helped to accumulate the broken shells that are often scattered abundantly over the bottom, both in deep and shallow water. Such accumulations of shells would soon become far more extensive than they are, if they were not attacked by boring sponges and annelids. Certain common sponges, belonging to the genus Cliona, very rapidly perforate the hardest shells in every direction, making irregular galleries, and finally utterly destroying them. On the outer grounds we dredge up rarely fragments of wood; but these are generally perforated by the borings of bivalves (usually Xylophaga dorsalis) and other creatures, and by them would evidently soon be destroyed.

We very rarely meet with the bones of vertebrates at a distance from the coast. Although these waters swarm with vast schools of fishes, while sharks, and a large sea-porpoise, or dolphin (Delphinus, sp.), often occur in large numbers, we very rarely dredge up any of their bones. In a few instances we have dredged a single example of a shark's tooth, and occasionally the hard otoliths of fishes. It is certain that not merely the flesh, but most of the bones also, of nearly all the vertebrates that die in this region, are very speedily devoured by the various animals that swarm on the bottom. Echini are very fond of fish-bones, which they rapidly consume. Fishes caught on the hooks in this region, and left down an hour or two, were nearly stripped of their flesh by small amphipod crustacea.

Relics of man and his works are of extremely rare occurrence at a distance from the coast, or even at a short distance outside of harbors, with the exception of the clinkers and fragments of coal thrown overboard from steamers with the ashes. As our dredgings are in the track of European steamers, such materials are not rare. A few years ago, even these would not have occurred. A rock forming on this sea-bottom would, therefore, not contain much evidence of the existence of man, nor even of the commonest fishes and cetaceans inhabiting the waters.

### 5. Fossiliferous magnesian limestone nodules.

At several localities in 234 to 640 fathoms, we dredged fragments and nodular masses or concretions of a peculiar calcareous rock, evidently of deep-sea origin, and doubtless formed at or near the places where it was obtained. These specimens varied in size from a few inches in diameter up to one irregular nodular or concretionary mass taken in 640 fathoms, which was 29 inches long, 14 broad, and 6 thick, with all parts well rounded. These masses differ much in appearance, color, tex-

ture, and fineness of grain; but they are all composed of distinct particles of siliceous sand, often very fine, cemented by more or less abundant lime and magnesia carbonates. Sometimes small quartz pebbles occur in them. The fine-grained varieties of the rock are often exceedingly compact, hard, and tough, usually grayish or greenish in color. They are often bored by annelids, sponges, etc., and are usually weathered brown, due to the presence of iron (probably in part as carbonate, sometimes as pyrite). The sand consists mainly of rounded grains of quartz, with some felspar, mica, garnet, and magnetite. It is like the loose sand dredged from the bottom in the same region. The calcareous cementing material seems to have been derived mainly from the shells of Foraminifera, abundantly disseminated through the sand just as we find the recent Foraminifera in the same region. In some cases, distinct casts of Foraminifera are visible in the rock. In some pieces of the rock, distinct fossil shells were found, apparently of recent species (Astarte, etc.). The larger masses appear to have been originally concretions in a softer deposit, which has been more or less worn away, leaving the hard nodules so exposed that the trawl could pick them up. The age of these rocks may be as great as the pleistocene, or even the pliocene, so far as the evidence goes. No rocks of this kind are found on the dry land of this coast. It is probable, however, that they belong to a part of the same formation as the masses of fossiliferous sandy limestone and calcareous sandstone, often brought up by the Gloucester fishermen from deep water on all the fishing-banks, from George's to the Grand Bank.

The chemical composition of these limestone nodules is of much interest geologically. Analyses made by Prof. O. D. Allen prove that they contain a considerable amount of magnesia. They are, therefore, to be regarded as magnesian limestones, or dolomites, of recent submarine origin. They also contain a notable quantity of calcium phosphate. The presence of the latter is not surprising when we consider the immense number of carnivorous fishes, cephalopods, etc., which inhabit these waters, and feed largely upon the smaller fishes, whose comminuted bones must, in part at least, be discharged in their excrements. In fact, it is probable that the greater part of all the mud and sand that cover these bottoms has passed more than once through the intestinal canals of living animals. The Echini, holothurians, and many of the star-fishes and worms, continually swallow large quantities of mud and sand for the sake of the minute organisms contained in it, and from which they derive their sustenance.

The following partial analysis by Prof. O. D. Allen gives the percentage of the most important constituents. The sample analyzed was a hard, compact, and very fine-grained magnesian limestone. Its color was yellowish green, with a darker green surface, weathered rusty brown in some places. It contained some minute specks of iron pyrite. Its specific gravity was 2.73.

*Composition of a deep-water limestone.*

| | Per cent. |
|---|---|
| Lime | 24.95 |
| Magnesia | 14.41 |
| Iron (estimated as protoxide) | 2.00 |
| Phosphoric acid (not weighed). | |
| Insoluble residue (sand) | 16.97 |

## WATER-BOTTLES AND THERMOMETERS FOR DEEP-SEA RESEARCH AT THE INTERNATIONAL FISHERIES EXHIBITION.

IT would naturally be expected that at an exhibition of this kind in England, where so much has been done in the past for deep-sea investigations, there would be found a good collection of the apparatus used in deep-sea work. Great Britain has, in fact, shown almost nothing of the kind; indeed, one may say, nothing whatever that especially relates to deep-sea investigation. After spending the not inconsiderable sum of money required to fit out the Challenger, the British government seems to have lost all interest in deep-sea exploration; and other nations are carrying on the work with greatly improved apparatus, while Great Britain rests content with the laurels already won.

The United States exhibit is the most complete of all, as regards apparatus of this kind. Denmark and Sweden have some apparatus for collecting specimens of water and observations of temperature, which, with the later forms used by the U.S. fish-commission and by the coast-survey, will form the main subject of this article.

The Swedish apparatus was devised by Prof. F. L. Ekman, principally for the use of the Swedish expedition of 1877, which carried out very thorough and systematic hydrographic investigations in the waters extending from the North Sea, through the Baltic, to the extreme end of the Gulf of Bothnia. Although the apparatus worked with entire satisfaction, it would scarcely be used at the present time, for it is unnecessarily heavy and large.

Two forms of apparatus for collecting samples of water from different depths are shown, both constructed on the same principle. The larger, having an ingenious means of closing, is chosen for description here. It consists of a brass cylinder open at both ends, about ten inches in length by four and a half in diameter, sliding freely through a space somewhat greater than its length, between three vertical brass rods or guides, which also constitute the frame of the apparatus. When the cylinder slides down, it encloses a vertical rod having a horizontal plate at the top, which forms a tight cover for the cylinder, similar to the end of a piston. The bottom of the cylinder falls into an annular groove in which a sheet-rubber ring is fitted, thus making a tight joint below. A rubber ring is also employed to make the upper joint tight. In the smaller instrument the lower groove is filled with a mixture of suet and wax; and the cylinder has an annular plate on top, the border of which extends inwards sufficiently to be bent downward so as to fit into a similar groove on the upper surface of the horizontal disk forming the top of the closed chamber. When the apparatus is sent down, the cylinder is suspended at the top. When it reaches the desired depth, the cylinder is released by a mechanism to be described, and falls, enclosing a sample of the water. In the smaller apparatus the cylinder is sustained during descent by the resistance offered by the annular plate above referred to, which is considerably larger than the diameter of the cylinder. On drawing up the apparatus, the plate also acts to force the cylinder well down into the grooves. In the larger instrument the cylinder is held up by a catch, actuated by a system of levers, which are connected with a turbine wheel enclosed in a brass case at the top. During descent the water passes through the case, entering and leaving it freely through strainers of brass gauze, and causes the turbine to revolve. The latter turns freely until the desired depth is reached. When ascending, the wheel makes a certain number of revolutions in the opposite direction, and soon acts upon the system of levers through a ratchet and ratchet-wheel, thus releasing the cylinder. This instrument has been successfully used in depths of three hundred metres. It is sufficiently good to enable the quantity of air contained in the water at different depths to be determined.

Arfwidson's water-bottle, exhibited by Denmark, is a simple cylinder of brass, shaped somewhat like a bell, closed by bottom and top plates with bevelled edges connected by a central stem. The bell falls, and the whole apparatus is drawn up by the central rod. The joints are made tight by grinding the plates and cylinder together. It is very simple, very light, and seems to be a good instrument. No information concerning its use is available at the present moment.

Another of Professor Ekman's instruments is used to collect samples of water, and also to enable the temperature to be correctly determined. Although quite different in construction from the others, it is the same in principle, except that it is made to protect the sample from any change of temperature while being drawn up, so that a thermometer may be introduced on deck to get the temperature of the stratum of water from which it was taken. The instrument has been found to give accurate results at depths of two hundred metres. It is not stated whether it has been used at greater depths.

In this instrument the cylinder is fixed between two galvanized iron rods, which, with four horizontal circular bands of the same material outside, constitute the frame, resembling a sort of cage. The top and bottom of the cylinder are formed by what may be described as two piston-heads connected together by a hollow rod, which slides up and down on another rod running vertically through the middle of the apparatus. The piston-heads are made of thick gutta-percha secured between brass plates. The connecting-rod is also covered with gutta-percha, and the cylinder itself is lined with it. Rubber is used to make the joints perfectly tight. The sample of water is thus protected by gutta-percha in every direction about two and a half centimetres in thickness. The upper piston-head carries a brass plate, which offers sufficient resistance to the water, while descending, to sustain it at the top of the apparatus. On hauling in, the water forces the piston down into the cylinder, enclosing the sample. The apparatus gives remarkably good results, if we may judge from some of the figures given in the case of a series of temperatures taken in the Baltic, where the alternations of cold and warm strata were quite remarkable. The temperatures were recorded to tenths of a degree of Celsius's scale, as, indeed, it was necessary that they should be, in order to make the results of unquestionable value; for the total variation in temperature between depths of 50 metres (when the temperature was 1°.8) and the bottom, 210 metres, was only 2°.1 C., yet there was a rise to 3°.9 at 100 metres, and a fall to 3°.1 at 210 metres.

No one would undertake to obtain such results with any deep-sea thermometer in use at that time. The Miller-Cassella instrument would utterly fail to record the temperatures at the bottom; and, even if it did record them, its readings would not be regarded as within half a degree F. of the exact temperature. The Siemens electric apparatus, which has been used on the Blake with great success, cannot be depended upon for greater accuracy than a quarter of one degree.

Capt. G. Rung of the Danish meteorological institute exhibits some thermometers enclosed within thick layers of cork, only the scales being exposed to view. In this way it is possible to obtain deep-water temperatures; for the instruments can be hauled upon deck, and readings made, before any heat can pass through the cork. This method, however, seems rather primitive; and, even if practicable, it is quite too slow to receive much commendation.

Fig. 1.

There can be no doubt that the best deep-sea thermometer is the latest Negretti and Zambra form, represented in fig. 1. It is so well known that a full description is not necessary; but as a reminder it may be said, that, when the instrument is upright, the mercury extends up into the tube to a height corresponding to the temperature. If then inverted, the mercury breaks at a particular point in the bend A, and runs down to the other end, where the temperature is read off. The small quantity of mercury in the bore does not appreciably change its length for slight variations of temperature. For a long time this has been the favorite instrument for taking deep-sea temperatures singly, but until lately no means had been devised for taking serial temperatures with it at a single cast. At the fisheries exhibition are shown three new methods of inverting the instrument at a given depth. The first we shall mention is exhibited by Capt. G. Rung of Denmark. It is scarcely worth while to describe this apparatus in detail; for, although it is undoubtedly an excellent device, the two other methods to be described are much better, because they are lighter and smaller. Capt. Rung inverts the thermometer by sending down a messenger along the line. By causing the inversion of each instrument to free a messenger to invert the next instrument below it, he obtains serial temperatures in the same manner as is done with the new device of Mr. W. L. Bailie, to be soon described.

Capt. Rung also exhibits a water-bottle and thermometer combined. A brass cylinder, perforated at the bottom with three small orifices, has a piston working air-tight within it. Within the piston-rod, which is perforated here and there, is a Negretti and Zambra thermometer, the bulb being at the outer extremity of the rod.

To use the apparatus, the piston is shoved in, and the end of the sounding-rope tied to the projecting end of the piston-rod. The apparatus is then inverted; and the lower end of the cylinder, being now uppermost, is secured to a catch a short distance up on the line. In this position it is lowered to the required depth, when a messenger is sent down which releases the cylinder. It falls, turns over, and the weight is then transferred to the piston-rod. The thermometer, being now bulb up, registers the temperature; while the weight of the cylinder causes it to pull the piston-rod out to the fullest extent, and, as the piston rises, it draws the water into the cylinder through the small holes in the bottom.

In figs. 2 and 3 we have illustrations of the ingenious apparatus devised by Commander Magnaghi of the Royal Italian navy, and exhibited by Messrs. Negretti and Zambra. It will be seen that the propeller-wheel C screws up or down as it revolves. During descent the propeller does not move, as the pin F is against the stop G. On reversing the motion, the propeller screws upward until the screw E releases the case, which then turns over, as in fig. 3, and is held in position by the spring K.

A still later form of this instrument has just been made, in which the thermometer-case is suspended on trunions at the lower end, instead of near the middle.

Another method for accomplishing the same result has been devised by Mr. W. L. Bailie, U.S.N. In his arrangement the case of the thermometer is attached to the sounding-wire by a cam-catch at the bottom, and by two lateral spring jaws at the top, which encircle the wire.

A brass messenger is sent down the wire when the desired depth is reached, which opens the jaws, thus releasing the top of the case. The latter then falls over, turning on a swivel at the bottom. A hook at the bottom carries a second messenger, which is released as the case turns over, and falls down to invert

the next instrument; and so on through the series. Instead of sending down a messenger on the wire, a propeller-wheel has also been arranged to open the jaws, so that either method may be employed.

The question arises, whether, with these excellent methods of using the instrument, the Negretti and Zambra thermometer cannot be made to record accurately to tenths of a degree. It would seem, that, by giving it a short range and a comparatively long tube,

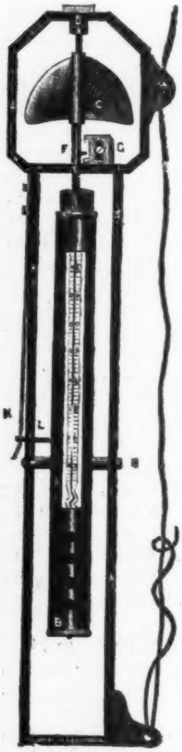


FIG. 2.

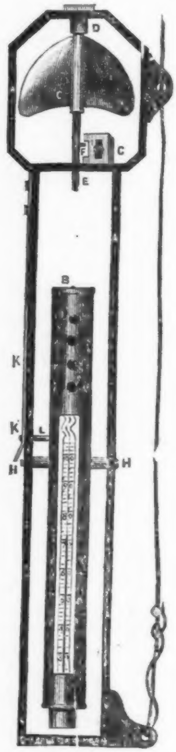


FIG. 3.

this might be done. If not, the most delicate observations for sub-surface temperatures will probably have to be made with some form of apparatus, which, like that used by Professor Ekman, brings the water to the surface in a case covered with a material through which heat cannot readily pass, or else by sending down a thermometer enclosed, like Capt. Rung's, in a thick case of non-conducting material.

R. HITCHCOCK.

London, June 1, 1883.

## REAL ROOTS OF CUBICS.

THEOREM I.

[IN the equation $x^3 + Ax^2 + B = 0$, when the roots are real, $A$ and $B$ have opposite signs; and simultaneously changing the signs of $A$ and $B$ changes signs of roots of equation.]

Assume $x = a$, $x = b$, $x = -\frac{ab}{a+b}$.

$$x^3 - \frac{1}{a+b}(a^2+ab+b^2)x^2 + \frac{1}{a+b}(a^2b^2) = 0; \quad (1)$$

and, changing signs of roots,

$$x^3 + \frac{1}{a+b}(a^2+ab+b^2)x^2 - \frac{1}{a+b}(a^2b^2) = 0. \quad (2)$$

Since the factors $(a^2 + ab + b^2)$ and $(a^2b^2)$ are positive when the roots are real, whatever the sign of $\frac{1}{a+b}$, $A$ and $B$ will have opposite signs, and, from (1) and (2), simultaneously changing signs of $A$ and $B$ changes signs of roots of equation.

THEOREM II.

$\left[\frac{A^3}{27}\right.$ is greater than $\frac{B}{4}$ in quantity.$\left.\right]$

$$\text{Assume} \quad \left(\frac{a^2+ab+b^2}{3(a+b)}\right)^3 > \frac{a^2b^2}{4(a+b)} \quad (3)$$

$$\text{or} \quad \left(\frac{a^2+ab+b^2}{3}\right)^3 > a^2b^2\left(\frac{a+b}{2}\right)^2;$$

$$\text{but} \quad \left(\frac{a+b}{2}\right)^2 \geq ab \quad \text{(Algebra):}$$

hence inequality (3) is true.

From (1), omitting the term $\frac{A}{3}$,

$$\frac{x}{\left(-\frac{B}{4}+\frac{A^3}{27}\right)^{\frac{1}{3}}} = \left(1+\frac{\sqrt{\frac{B}{4}}}{\sqrt{-\frac{B}{4}+\frac{A^3}{27}}}\sqrt{-1}\right)^{\frac{2}{3}} + \left(1-\frac{\sqrt{\frac{B}{4}}}{\sqrt{-\frac{B}{4}+\frac{A^3}{27}}}\sqrt{-1}\right)^{\frac{2}{3}}; \quad (4)$$

and, from (2),

$$\frac{x}{\left(\frac{B}{4}\right)^{\frac{1}{3}}} = \left(1+\frac{\sqrt{-\frac{B}{4}+\frac{A^3}{27}}}{\sqrt{\frac{B}{4}}}\sqrt{-1}\right)^{\frac{2}{3}} + \left(1-\frac{\sqrt{-\frac{B}{4}+\frac{A^3}{27}}}{\sqrt{\frac{B}{4}}}\sqrt{-1}\right)^{\frac{2}{3}}. \quad (5)$$

In (4) the coefficient of $\sqrt{-1}$ may have any magnitude, and in (5) the coefficient of $\sqrt{-1}$ is the reciprocal of that magnitude. And since from any cubic (Theorem I.) (4) or (5) may be obtained, it follows, that, when the real part is unity, the coefficient of $\sqrt{-1}$ may be made less than unity, and real (Theorem II.).

Put $n$ = coefficient of $\sqrt{-1}$, we have, by expansion,

$$(1+n)^{\frac{1}{3}} + (1-n)^{\frac{1}{3}} =$$
$$2-4\left(\frac{1}{3\,.\,6}\right)n^2 - 4\left(\frac{4\,.\,7}{3\,.\,6\,.\,9\,.\,12}\right)n^4 - 4\left(\frac{4\,.\,7\,.\,10\,.\,13}{3\,.\,6\,.\,9\,.\,12\,.\,15\,.\,18}\right)n^6, \text{ etc.}$$

The series, already converging, is made doubly converging by the high powers of $n$, since $n$ has been made a fraction. Putting $n$, for example, no smaller than $\frac{1}{10}$, the correction for the sum of the series at the eighth term would be less than $\frac{1}{1,400,000,000,000,000,000}$. And, as the precision of the value of $x$ is determined proportionally to the accuracy with which the series is summed, it follows that a good approximation to $x$ may be obtained by using a very few first terms of the series.

A. M. SAWIN.

## *THE HABITS OF MURAENOPSIS TRIDACTYLUS IN CAPTIVITY; WITH OBSERVATIONS ON ITS ANATOMY.*

THE Louisianian district of the Austroriparian region is a particularly rich field for the herpetologist. Thirty-six species of reptiles are known to be confined to its limits alone, not to mention a long list of others that range generally over the southern states; and to these we must add those species which are mentioned by the old French authors, but have not yet been taken by American naturalists, a knowledge of which fact always enhances the interest of a country in the eyes of the explorer, who pushes his way through its tangled jungles, or visits its unfrequented spots and its sultry forests, for the first time.

After my arrival in New Orleans, the months that are included in the pseudo-winter of this sub-tropical land came and passed by, before my collection could boast of a single specimen representing the Amphiumida: indeed, it was not until April had almost made its appearance that a superannuated old negro presented himself one morning with a live but rather small specimen of the three-toed siren, the subject of this essay.

He called it a 'Congo eel,' — a name which is indifferently applied by every one here, intelligent as well as ignorant, to both this reptile and Amphiuma means. Long before this, reports had come to me from far and near of the dreaded 'Congo,' or 'lamprey' as it is often called. It was universally said that its bite was invariably fatal. To such an extent was this believed, that, I am told, a physician of the city, of undoubted reputation in his profession, and a capital chemist, but possessing nothing more than a general knowledge of natural science, was actually making experiments with the view of examining the venom of this innocent amphibian. When my aims became pretty thoroughly known throughout my section of the country, I applied a very different kind of analysis to this problem: a good round sum of money was offered to any one who would bring me the full record of a well authenticated case of death from the bite of the Congo snake, or eel. It is almost needless to add, that I never had to pay the reward. One person, more mercenary than well informed in such matters, did bring forward a case of an hysterical old colored woman who had been bitten several years ago by a Congo eel, and died *six months* after the infliction of the wound, in spasms!

The small one, which now came into my possession, was placed in water, in a large comfortable vessel, for observations upon his habits, before he was finally consigned to his tank of alcohol. In handling him, he rarely

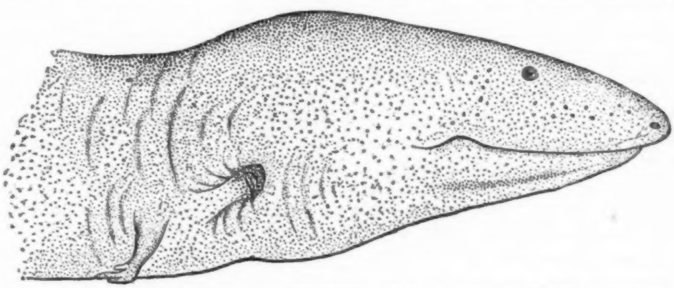


FIG. 1. — Life-size head of Muraenopsis tridactylus; adult. Drawn from the living specimen by the author.

offered to bite, unless the examination was prolonged or roughly conducted; then he would curl up, slowly open his mouth, and make an awkward longe at the fingers or hand that held him. Sometimes he would only open his mouth, and hiss in a subdued manner. On one occasion, however, this reptile succeeded in getting out of his tub during the night. When I found him, in the morning, in a distant part of the room, he snapped at me quite savagely several times before he was retaken. It was amusing to see the way in which he succeeded in leaping out of his place of confinement, — a large tin bath-tub, with the water seven or eight inches below the brim. He swam round and round with increasing rapidity till the necessary impetus was acquired, when he would prettily make a sort of spring over the side of his tub on the floor, where he would squirm round like an eel until he was replaced. In such situations he uses his legs to the full extent to which they seem capable of being put; in the water, too, these members are constantly brought into use, — the fore-pair when he desires to move very slowly forward, in which case he may or may not, generally not, use the hind-pair in aiding the action. The fore-pair are also used alternately to push himself one way or another, when he wishes to change his course. A common use for the hind-pair, is to throw them forward, and brace them against the ground he may be passing over, in order to check his onward movement either partially or entirely. In swimming about he has all the appearance of the common eel; and during these times he draws both pairs of limbs close beside his body, when his action is graceful and interesting to behold.

When these sirens are at rest, they either stretch out in gentle curves, sluggishly along the bottom, or, what is not very uncommon for them to do, curl up tightly, in a spiral manner, the latter two thirds of their length, while the head and remaining third is protruded forward in a direct line. In this curious position they float near the surface, the head being lowermost. If two occupy the same vessel, they often curl about each other in a rather affectionate manner; but I have never witnessed them quarrel or fight. One time I threw a dead king-snake into the tub of my first small specimen, the snake being at least three times as long as the siren. Imagine my surprise to see him fly at the intruder, seize him just below the head, straighten out as stiff as he could, then rapidly whirl round, as a drill does, causing the dead snake to be spirally coiled about his body. A moment of quietude followed this strange manoeuvre, during which time one could see a crunching movement on the part of the jaws of the siren going on; but, finding his enemy showed no resistance, he slowly let go his hold, and, freeing himself from the dead snake's coils, swam about the tub without paying him any further attention. In a few moments, however, I repeated the experiment, when he made the same attack with just as much vigor as before; but all subsequent trials failed, and I could never induce him to take further heed of such a harmless enemy.

This siren will eat crayfish in confinement; but I could never induce one to take any thing else, although raw meat is the commom bait used by the negroes in catching them for me. Sometimes before a meal, or may be after, your captive will swim gracefully about his limited quarters, and occasionally rise to the surface, stick his nose out of the water, and give vent to a loud blowing sound, that may be heard anywhere in a large room, even if conversation be going on. As remarked above, my collectors usually took such specimens as were brought me, with the ordinary hook and line, baited with fresh meat; but very often they are captured in hand dip-nets, or even thrown out of a shallow drain or bayou with a stick. They are most numerous after heavy rains, when their usual places of resort are flooded over. When taken by others than those who are collecting for me, they are invariably despatched on the spot, and dreadfully and wantonly mutilated, so deep-seated is the detestation and dread of this harmless creature in the minds of all the people hereabout.

In a large, shallow tank of water, I have before me now two fine living specimens of this siren, which have been under my observation for nearly a fortnight. The larger of these two has a total length of eighty centimetres, with a mid-girth of fourteen centimetres. I have kept specimens alive that measured a hundred or more centimetres, but they have since been consigned to alcohol. The specimen now before me, just measured, is of a dark olivaceous brown above, and entirely so on all the parts beyond the hind-pair of limbs. A patch of this color is also found upon the throat. The color of the under parts is a dull, whitish leaden hue, being mottled with an intermediate shade as it joins the darker and more sombre color of the dorsal aspect of the body. This mottling grows denser as it approaches the hinder limbs, where finally it merges into the general tint of the upper sur-

face, which is carried over the tail. A faint lateral crease is found along the mid-third of the body, with feeble corrugations crossing it vertically, that are quite evident as the creature writhes about, and the eel-like slime that naturally covers his entire body partially dries. The limbs are pretty well developed: each is three-fingered, or, better, each possesses three digits. The hinder limbs are larger than the fore ones, and stronger in every way. The body tapers to a tail beyond the genital fissure, but no well-marked constriction indicates to us its exact commencement, or attachment to the body. It is rounded beneath, and finished off along the median dorsal line with a thickened, feebly pronounced crest. Sections made through the body itself, between the fore and hind limbs, are elliptical, with the major axes in the horizontal plane. I have taken other measurements from this specimen, which I present in the form of a table.

| | |
|---|---|
| Total length | 80.0 cent. |
| Mid-girth | 14.0 " |
| Length of fore-limb | 1.7 " |
| " " hind-limb | 2.5 " |
| " " head | 6.5 " |
| Distance between the eyes | 2.0 " |
| " " " nostrils | .6 " |
| " " mid-points bet'n eyes and nostrils, | 2.2 " |
| Gill-cleft from eye | 4.2 " |
| Fore-legs apart | 3.1 " |
| Hind-legs " | 2.2 " |
| Length of genital fissure | 1.2 " |
| Commissure of jaw from gill-cleft | 3.0 " |
| From a point midway between hind-limbs to tip of tail, | 20.0 " |

The nasal apertures are very small, and the eyes are black, round, a little more than a millimetre in diameter, and devoid of lids.

I may remark here, that, while engaged in taking these measurements, this specimen succeeded in seizing my thumb in his mouth, and immediately commenced his peculiar gyrations, turning himself in the long axis of his body; but I was too strong for him, and soon disengaged myself. The bite caused no more inconvenience than those I have received from alligators a month old.

The upper lips of the three-fingered siren are thin-edged and pendulous, extending from the commissure of the jaw to a point nearly opposite the nostril on either side, where they merge into the rounded snout. The lower lips do not meet in front by a centimetre. They are likewise thick and sharp-edged, overhanging the common integument of the lower jaw, and originating posteriorly within the commissure and beneath the upper lips. Minute glandular openings are seen on the head above, and in the maxillary space beneath, symmetrically arranged in rows, as on other parts of the body. We find the gill-clefts with two obliquely placed lips, with which they can be closed, the anterior one being the larger. The internal openings to the gill-clefts are far back in the pharynx, nearly opposite the rudimentary and partially cartilaginous larynx, which latter communicates directly with the superior extremities of the membranous pulmonary air-passages. A pair of normal lungs are among the most exquisite of structures in any vertebrate. Here they are particularly beautiful, being very long, cylindrical in form, extending far down into the abdomen, to terminate in pointed extremities. The right is thirteen centimetres longer than the left, and is carried nearly down to a point opposite the cloaca. From one end to the other, the alimentary tract is nearly or quite a straight tube. The oesophageal portion is rather small and tubular, with a few circular constrictions in its lower third. This division soon dilates into a spindle-shaped stomach of some size, which, in the specimen before me, is fourteen centimetres below the pharyngeal aperture. Below this last dilation the intestinal tract is carried straight to the cloaca, or rectal enlargement, into which the urinary and genital organs open. A very peculiar feature is noticeable in the circular constrictions that occur in the intestine at irregular intervals along its length. Very dark in color, the many-lobed liver is about twenty-six centimetres long, and covers at its lower tenth, or thicker extremity, an ellipsoidal gall-bladder of no small size. Many features of interest and importance present themselves in the circulatory and renal systems; but our space will not permit us to enter upon them here, as we have something to say about the osteology of Muraenopsis. Among other organs, a well-developed pancreas is to be observed; and the Wolffian bodies are present, and their dilated upper extremities are about opposite the lower end of the liver.

The tongue in this siren is in an extremely rudimentary stage of development. I will close this brief sketch of the anatomy of the soft parts — yet it can hardly be termed a sketch, for many structures have not even been alluded to — by calling the reader's attention to the remarkable length of time that nervous excitability, if I may apply such a term to the phenomenon, was kept up. My specimen was killed with chloroform. That of itself took a long time, forty minutes or more; but what is this, compared with the fact that its heart continued to pulsate in good rhythmical time during three hours and a half of my operations, and after the most extensive dis-

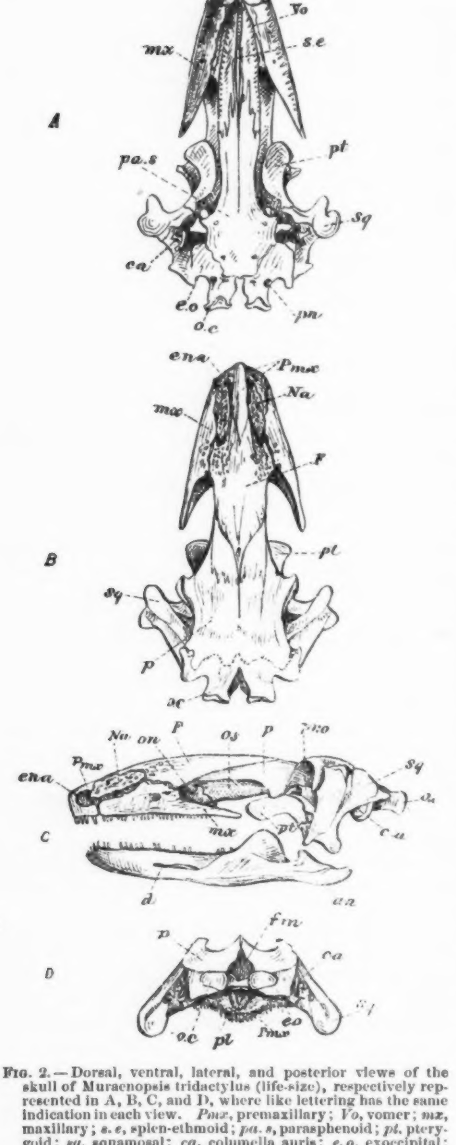



FIG. 2.—Dorsal, ventral, lateral, and posterior views of the skull of Muraenopsis tridactylus (life-size), respectively represented in A, B, C, and D, where like lettering has the same indication in each view. *Pmx*, premaxillary; *Vo*, vomer; *mx*, maxillary; *s. e*, splen-ethmoid; *pa. s*, parasphenoid; *pt*, pterygoid; *sq*, squamosal; *ca*, columella auris; *e. o*, exoccipital; *o. c*, occipital cordyle; *pn*, foramen for exit of pneumogastric and glosso-pharyngeal nerves; *ena*, external nasal aperture; *Na*, nasal; *F*, frontal; *p*, parietal; *on*, foramen for the passage of of the orbito-nasal nerve, the first division of the fifth pair, to the rhinal cavity; *os*, orbito-sphenoidal region; *pr. o*, pro-otic; *d*, dental element of mandible; *an*, angulae; *fm*, foramen magnum; *pl*, roof of the mouth.

sections had been made? And four hours and a half after, when all the organs had been removed, and inroads made upon the trunk, this creature would still writhe vigorously by simply pinching his tail, or close his jaws like a vice in a way that would put the hardiest of eels to shame, and crush any claim the latter might have in standing at the head of the list of those animals most tenacious of life. We find the cranium of Muraenopsis very thoroughly ossified, and many of the sutures observable only after close inspection. The teeth are of the pleurodont type, and may be seen in all stages of development in the deep grooves that exist in the mandible, the maxilla, the premaxilla (which usually supports twelve), and the entire inner margins of the descending plates of the vomers, which meet each other anteriorly (fig. 2, A). A long, slender, sphen-ethmoid is inserted between these last bones, quite distinctly seen on the inferior aspect.

The premaxilla throws backward a nasal process that overlaps the frontals above, and passes between the nasals. These latter segments are very much honeycombed and grooved, —a characteristic which is adopted by the anterior extremities of the frontals and the upper parts of the maxilla on either side. The coronal suture is seen beyond, a demi-lozenge shaped and elevated plate, developed by the united frontals, directed backward (fig. 2, B). Each outer margin of the parietal region is raised into a curling crest, as if pushed up by the unusually large squamosals, which lend to the lateral aspect of the skull of this creature such a massive appearance. As in other Urodela, a large columella auris is seen on either side, external to the extensive processes that project backward, to bear the occipital condyles (fig. 2, D). A pro-otic is well developed; but it is difficult to determine in the adult cranium whether a separate epiotic and opisthotic exist or not, though I am strongly inclined to think they do not. The pterygoids are completely ossified, and quite extensive, horizontally flattened, and curved plates of bone, their anterior extremities being prolonged with a fibrous tissue to form the floors of the orbits. The lower maxilla is very deep and solid; and, although the meeting of the dentary elements anteriorly is quite extensive, the symphysis is not firm. Nearly the entire basicranial region is occupied by the widespreading and anteriorly produced parasphenoid (fig. 2, A), which, with its serrated margin, articulates with the parallel vomerine plates beyond.

We have presented us for examination in

the hyoidean apparatus (fig. 3) two reniform hypo-hyals in cartilage, surmounted by a triple piece of the same material that occupies the usual site of the glosso-hyal. In the median line we have a thoroughly ossified basi-hyal; while curved bony cerato-hyals, with expanded cartilaginous anterior ends, are suspended from the hypo-hyals. Four branchial arches are represented; the first pair being long, curved bones, and the remaining ones cartilage. The gill-clefts open to the rear of the last pair on either side.

The spinal column of an adult Muraenopsis contains one hundred and ten well-ossified vertebrae. The second and third of these have suspended from their transverse processes free ribs, of which the anterior pair is the larger. A strongly marked intercondyloid process is formed between the two concave facets on the anterior aspect of the atlas. As a rule, all these vertebrae, except the first and the extremely rudimentary caudal ones, are of the amphicoelous type, with lofty neural spines,—far-spreading transversed processes that become horizontally broadened in mid-spinal region,—and with well-marked zygapophysial processes to link the series together. None of these vertebrae are modified to form a sacrum in con-

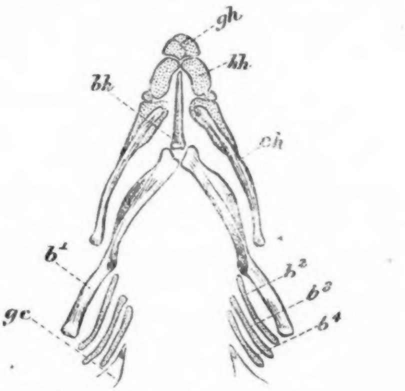



FIG. 3.—Hyoidean and branchial apparatus of Muraenopsis tridactylus; life-size; dotted parts in cartilage; *gh*, rudimentary glosso-hyal; *hh*, hypo-hyal; *ch*, cerato-hyal; $b^1$, $b^2$, $b^3$, and $b^4$, branchial arches; *gc*, gill-cleft.

nection with the pelvis in the precaudal region; beyond which, each segment throws down parial hypapophysial processes, which are not lost, as we proceed backwards, until we arrive at the ultimate nodules that complete the tip of the tail.

In my specimen the thirty-third and thirty-fourth vertebrae have coalesced in the most remarkable manner, forming one bone, with nearly all the parts double. The appendicular skeleton is represented by extremely rudimentary shoulder and pelvic girdles, supporting equally feebly developed limbs, with their segments arranged as seen in fig. 4. We find

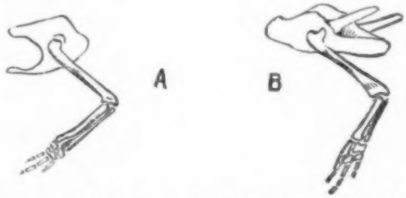



FIG. 4.—A, right fore-limb and rudimentary shoulder-girdle; B, right hind-limb and rudimentary pelvis, both slightly enlarged, of M. tridactylus. From dissections by the author.

the carpus has three cartilaginous elements in its structure,—two in the proximal row, and only one in the distal. This number is increased by an additional segment in the tarsus, which has two elements in each row, articulating with the digits, as shown in the figure.

Osseous tissue of an elementary character may be deposited in the humerus, the femur, and certain points in the pelvis, more particularly the projecting rod that appears to represent the pubic bone; otherwise all this part of the skeleton in our siren remains in cartilage throughout life. R. W. SHUFELDT.

## *THE GREAT TERMINAL MORAINE ACROSS PENNSYLVANIA.*[1]

**AFTER describing the investigations which elsewhere had demonstrated the existence of a true terminal moraine to the glacier covering north-eastern America, the author stated, that having obtained the aid of the geological survey of Pennsylvania, and, during a portion of his work, the assistance of Prof. G. F. Wright, he had been able to follow and define the southern limit of glaciation for the first time in a continuous line four hundred miles in length, and to find that it was everywhere marked by a remarkable accumulation of glaciated material, which, winding across mountains and valleys, from the lowlands of the Delaware to the great Alleghany plateau, was continuous from end to end, and formed a true terminal moraine.**

**There is a marked distinction between the glaciated portion of Pennsylvania and that region south of glacial action. Although the general topography of the two regions is alike, the varied superficial features due to glacial agencies, the far travelled and scratched bowlders, the smoothed and striated**

[1] Abstract of a paper before the American association for the advancement of science, in Montreal, August, 1882. By Prof. H. CARVILL LEWIS.

rock-exposures, the unstratified deposit of till, the many kames, and especially the numerous glacier-scratched fragments and pebbles, — all these deposits are in strong contrast with those south of the moraine, where all the gravels are stratified and the pebbles water-worn, where the rocks are never polished or striated, but, on the other hand, often decomposed to a great depth, and where, except near the seacoast, wide stretches of the more elevated regions are perfectly free from all drift.

The method employed in discovering the line of the moraine was to zigzag along its course from the glaciated into the non-glaciated region, and *vice versa*, going each time far enough on the one side to be fully satisfied of the absence of glaciation, and, on the other, to find undoubted traces of its action.

Nowhere south of the line of the terminal moraine had he found any traces of glacial action, *all statements by other geologists to the contrary notwithstanding*. When typically developed, the terminal moraine is characterized by peculiar contours of its own. A series of hummocks, or low conical hills, alternate with short straight ridges, and enclose shallow basin-shaped depressions, which, like inverted hummocks in shape, are known as *kettle-holes*. Large bowlders are scattered over the surface; and the unstratified till which composes the deposit is filled with glacier-scratched bowlders and fragments of all sizes and shapes. The average width of the moraine is about one mile.

At many places, however, the limit of glaciation is marked merely by an unusual collection of large transported bowlders. This is especially the case in front of a high mountain range which has 'combed out' the drift from the ice.

The general course of the moraine across Pennsylvania was defined as follows: appearing first in Northampton county, a mile below Belvidere, at latitude 40° 49′, it winds in a great curve, first westward and then northward, reaching the base of the Kittatinny Mountain, three miles east of the Wind-Gap.

Ascending to the top of the Kittatinny Mountain, sixteen hundred feet high, the moraine crosses the great valley between the Kittatinny and the Pocono, and then swings sharply back and around Pocono Knob, immediately afterwards to ascend the steep face of the mountain to the wide plateau on top, twenty-one hundred feet above the sea. Crossing this in a fine curve, and heaped up in an immense accumulation, it goes first north and afterwards west, reaching the gorge of the Lehigh River, some ten miles north of Mauch Chunk. It crosses the gorge at Hickory Run, and, without swerving from its general north-western course, ascends mountain range after mountain range, descends to the valley of the east branch of the Susquehanna, and crosses the river at Beach Haven.

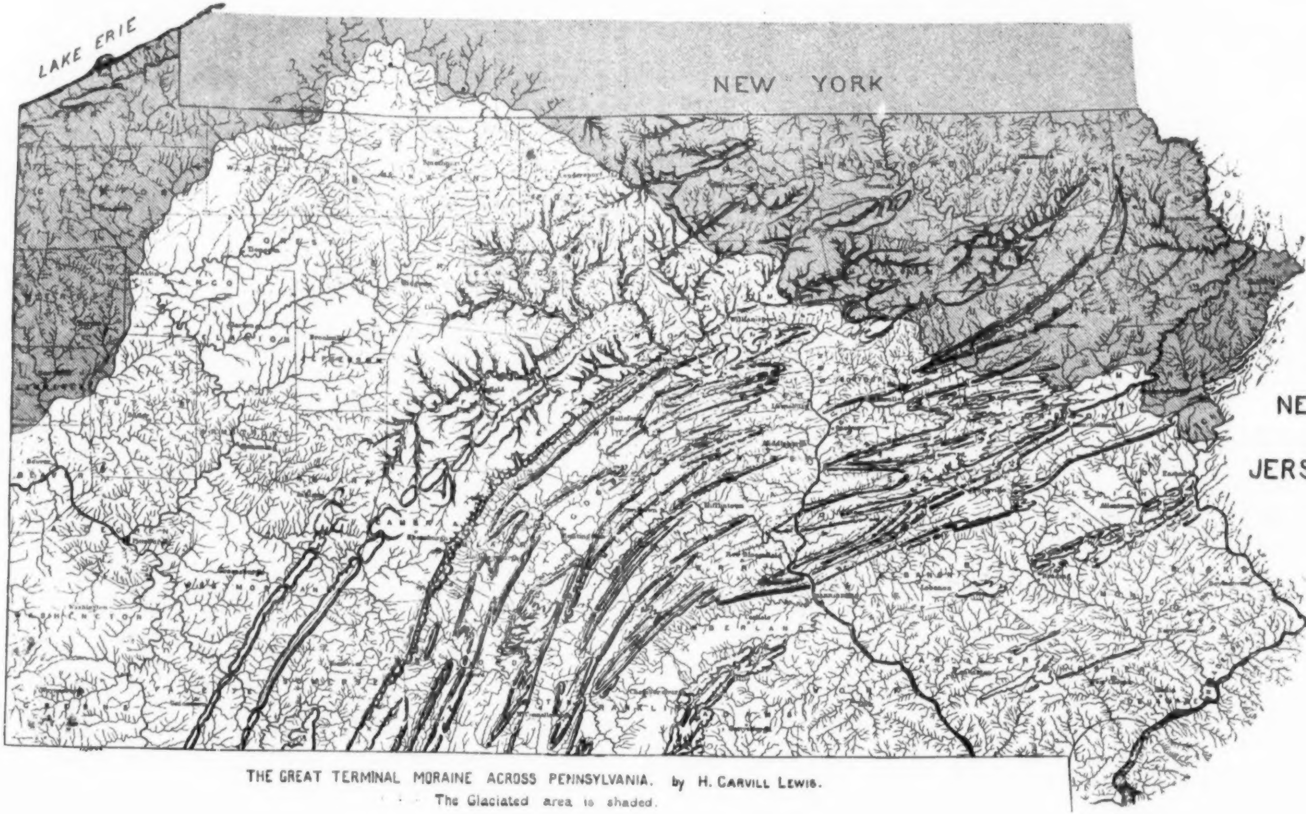
Then, following the base of Huntington or Knob Mountain, it finally ascends it, and crossing its summit, at a height of fifteen hundred feet above the Susquehanna just below, descends the north slope of the mountain to the broad, undulating valley to the north. Taking a northerly course, it follows up on the east bank of Fishing Creek to the North or Alleghany Mountain, enters Lycoming county, passes westward along the base of the mountain, crossing in its course the Muncy and Loyalsock creeks, and then, near the village of Loyalsock, turns at right angles, and ascends the mountain.

Having reached the summit of the Alleghanies, over two thousand feet above the sea, it passes west through a wild, wooded region nearly as far as Pine Creek, where it begins a nearly straight north-westward course through the south-west corner of Tioga county, and the north-west part of Potter. In the high ground of Potter county, the moraine crosses a great continental watershed, from which the waters flow into the Gulf of Mexico, Lake Ontario, and Chesapeake Bay. The moraine is here finely shown at an elevation of twenty-five hundred and eighty feet, being higher than elsewhere in the United States.

It now enters the state of New York in the south-west corner of Allegany county. Passing still north-west, and entering Cattaraugus county, it twice crosses the winding course of the Allegheny River, east and west of Olean; then trending to a point five miles north of Salamanca, in latitude 42° 15′, it forms a remarkable apex, whence to the Ohio line its course is south-west. Turning at right angles to its former course, the moraine passes south-west through the south-east corner of Chautauqua county, and, keeping approximately parallel to the course of the Allegheny River, re-enters Pennsylvania in Pine Grove township, Warren county. It crosses the Conewango River seven miles north of Warren; then trending west, still at a general elevation of nearly two thousand feet above the sea, it crosses one gorge after another, and forms a line separating not only the glaciated from the non-glaciated region, but also the cultivated from the uncultivated and densely wooded region. It crosses the south-east corner of Crawford county, skirts the north-west and west boundary of Venango county, crosses Beaver River eight miles south of New Castle, and, traversing the extreme north-west corner of Beaver county, crosses the Ohio state line in the middle of Darlington township, thirteen miles north of the Ohio River.

The moraine thus leaves Pennsylvania at precisely the latitude at which it entered the state; and, if a straight line were drawn across the state between these two points, the line of the moraine would form with it a nearly right-angled triangle whose apex was a hundred miles distant perpendicularly from its base. The total length of the moraine, as here shown, is about four hundred miles. The moraine crosses the Delaware at an elevation of two hundred and fifty feet, the Allegheny at an elevation of fourteen hundred and twenty-five feet, and the Beaver at an elevation of eight hundred feet, above the sea, or two hundred and twenty-five feet above Lake Erie. Upon the high lands it rises higher by a thousand feet or more.

Coming to the details of the moraine, many of which are of great interest, reference was made to its fine development in Northampton county, west of




THE GREAT TERMINAL MORAINE ACROSS PENNSYLVANIA. by H. CARVILL LEWIS.
The Glaciated area is shaded.

Bangor, where it forms a series of hummocky hills, which, a hundred to two hundred feet in height, and covered with transported and striated bowlders, rise abruptly out of a clayey plain to the west. Glacial striae upon exposed surfaces near Bangor point south-west, or towards the moraine. After following the moraine to the base of the Kittatinny Mountain, it became of great interest to know whether a great lobe of ice descended from New Jersey along the lower side of the mountain, or whether a tongue projected through the Delaware Water-Gap, or whether the glacier, even so close to its southern limit, came bodily over the top of the mountain, unchecked by it, and unchanged in its course. The last, the most improbable of these hypotheses, and certainly the least expected by the author, proved to be undoubtedly the true one. The author had been able to show that the moraine crossed the mountain near Offset Knob; that large bowlders, derived from lower elevations several miles northward, lie perched all along the summit, fourteen hundred feet above the sea; and that, as shown by the numerous striae on the northern slope of the mountain, running *up-hill*, the glacier moved diagonally up and across the mountain, uninfluenced in any way by the presence of the Water-Gap, and finally came to an end in the valley south of the mountain, as marked out by the terminal moraine. Huge bowlders of fossiliferous limestone, sometimes thirty feet long, were torn by the ice from their parent strata in Monroe county, on the north side of the mountain, lifted up a thousand feet, carried across the mountain, and dropped finally in the slate valley of Northampton county. The author had found one of these limestone bowlders upon the very summit of the mountain, where the jagged sandstone rocks had combed it out of the ice during its passage across. The journeys of these bowlders were short; but that of a well-rounded bowlder of Adirondack syenite, which the author had found in the same county, was about two hundred miles.

Another interesting point is in Monroe county, upon the summit of Pocono Mountain, over two thousand feet above the sea, where a great ridge of moraine hills twelve miles long, one mile wide, and a hundred or more feet high, composed of unstratified till, and bearing numerous bowlders of Adirondack gneisses and granites, rises out of the level, sandy plain of the Pocono plateau, and sweeps around from Pocono Knob into Carbon county. Known locally as 'Long Ridge,' its origin had never before been suspected. It encloses remarkable little 'moraine lakes' without inlet or outlet, and is heaped up into just such conical hills as may be seen in the moraine in southern Massachusetts. Nothing can more clearly show the continuity and uniformity of action of the great glacier than the identity of its moraine accumulations at such remote points.

In fact, the course of the moraine, as it winds from the top of the Kittatinny Mountain down to Cherry valley, and then up again on to the Pocono, is a complete vindication of the glacial hypothesis. It is in no sense a water-level, nor could it have been formed by floating ice. No other cause than that of a great glacier could form a continuous accumulation of glaciated material which contains no evidences of water-action, and which follows such a course. Neither on the mountains nor in the valley does the moraine rest against any defined barrier, as would be the case were it a shore-line.

The kames of Cherry valley, fine examples of which appear south of Stroudsburg, are interesting relics of sub-glacial water-action. They are composed of stratified water-worn gravel, having often an anticlinal structure, and as a series of conical hills and reticulated ridges, enclosing 'kettle-holes,' form conspicuous objects in the centre of the valley. They appear to have been formed by sub-glacial rivers, which, flowing from the moraine *backwards*, under or at the edge of the ice, emptied into the Delaware valley. They thus probably differ in origin from the longer kames in New England, and other regions more remote from the edge of the glacier.

The glacier had produced very slight effect upon the topography of Pennsylvania. It neither levelled down mountains nor scooped out cañons. The glacier passed bodily across the sharp edge of the Kittatinny Mountain without having any appreciable effect upon it, the glaciated part of the ridge being as high and as sharp as that part south of the moraine.

In describing the course of the moraine across Luzerne county, the author showed that it crossed several mountain chains in succession, by each of which it was locally deflected northward. At the point where the terminal moraine crosses Buck Mountain, in a line diagonally across the mountain, the moraine was so sharply defined that he was able to stand with one foot upon the glaciated and the other upon the non-glaciated region. It was interesting to find, that in *front* of a mountain chain, such as Huntington Mountain or the Alleghany Mountain, the moraine was poorly developed, as though the mountain had 'combed out' the drift from the ice.

He described an instructive portion of the moraine, where, three and one-half miles north-west of Berwick, it seems to abut against a high slate hill, which furnishes, therefore, a *section* of the end of the glacier. It shows that the extreme edge of the ice was here only about four hundred feet thick, and that, while the moraine and the scratched pebbles were carried along at the base of the ice, sharp fragments of sandstone were carried on top.

In speaking of the apex made by the moraine in New York, and of the high plateau region of Potter county, it was inferred, from the local influence already shown by the author to have been exerted by single mountain chains, that this region of high elevation had a decided influence upon the general course of the moraine.

Certain facts observed as to the gravel-ridges of the Allegheny River rendered it probable that the river flowed under a tongue of the glacier, ten miles broad and two miles long, through a sub-glacial channel, at the time of its greatest extension near Olean. He

described a great natural dam across the valley of the Great Valley Creek, near Peth, where the moraine stretches across the valley from side to side; and he spoke of the contrast between the numerous drainage valleys which drained the waters of the melting ice into the Allegheny River, and those valleys which took their rise south of the moraine, and were free from all drift.

After giving some details of the western lobe of the ice-sheet, and dwelling upon the agricultural significance of the moraine, he spoke of some curious deposits of glaciated material which occurred in a narrow strip of ground immediately in front of the moraine, and which he had named the 'fringe.' These deposits consisted of bowlders of Canadian granite, and other rocks, which he found perched upon the summits of hills, sometimes as far as five miles in front of the moraine, though never farther. This glacial 'fringe,' confined to the western part of the state, was found to increase in width from two miles in Warren county to five miles on the Ohio line, and was at first a puzzling phenomenon. The hypothesis suggested was, that, like breakers on the seashore, the top of the ice overreached the lowest strata by the width of the 'fringe,' and that while the moraine marked the halting-place of the bottom of the ice, by which it was formed, the far-transported bowlders were carried on more rapidly in the top strata of the ice, and were dropped outside of the moraine to form the 'fringe.' It was stated that the striae in the western part of the state all pointed south-east, being at right angles to those in the eastern part of the state, but, like them, pointing always towards the moraine.

In conclusion, the author reviewed the more important facts discovered during his exploration of the line of the moraine, dwelling upon the character of the moraine where crossing river-valleys, the absence of proof of any tongues of ice down such valleys, the absence of glacial drift south of the moraine, the very slight erosion caused by the passage of the glacier, and especially upon the deflections, large and small, in the line of the moraine, which were inexplicable on any other hypothesis than that the moraine now described was pushed out at the foot of a continuous ice-sheet of immense extent.

## *LETTERS TO THE EDITOR.*

### Change of birds' notes.

For some years it has been known to many about here, that in one locality the cardinal bird (Cardinalis virginianus) has been in the habit of imitating the notes of the whippoorwill (Antrostomus vociferus). From articles I have read from time to time in various scientific journals, I infer that it is not generally known that birds ever, in the wild state (especially cardinalis), change their song. I therefore thought it well to report this case. I have in several instances known this bird to change its song, under confinement, for one entirely different; but this is the only case I have ever known where such a thing has occurred in the wild state. I have known of this case for about ten years. F. O. Jacobs.

Newark, Licking county, O.

### St. David's rocks and universal law.

The article with the above heading in Science of June 15, by Dr. M. E. Wadsworth, has just come under my observation; and, as it refers to questions which have arisen chiefly in consequence of my researches among those rocks, I shall deem it a favor if you will allow me space in Science for a few remarks in explanation. Professor Geikie's paper was written with, as he states, 'a sense of duty' to 'defend the views of his predecessors;' and it is perfectly certain, from the hasty manner in which the work was gone over by Professor Geikie and his two assistants, that the object was to vindicate the work of the Geological survey of thirty or forty years ago, rather than to apply the knowledge gained by the work of many independent observers since that time to correct the errors well known to have been committed by the surveyors, which remain as blots on the maps even now issued by the Geological survey. In the district of St. David's, these maps show a great intrusive mass passing under the city of St. David's, about eight miles in length, and with an average width of about a mile. The southern portion is called syenite, and the other felstone. The rocks lying along the north-western edge for about a mile in width are colored as altered Cambrian, presumably as the result of the intrusion; but on the south-east the rocks of the same age are supposed to be in contact with the mass in an unaltered condition, and without even a line of fault to separate them. These appearances were curiously anomalous if true: hence I felt it necessary to go very carefully into the question. My large acquaintance with the district, and the knowledge I had obtained in my explorations among the lower fossiliferous rocks of the area, enabled me to do this with some advantage. I had also, from time to time, much valuable assistance from Professors Harkness, Hughes, and Bonney, and from Mr. T. Davies of the British museum, Mr. Tawney, etc.

I found that under the same name, rocks of very different characters had been grouped together. The so-called syenite ridge was seen to consist in part of granitoid rocks, but also of quartz-felsites, of hälleflintas, of breccias, and of porcellanites freely traversed by intrusive dikes of various kinds. The so-called metamorphic Cambrian on the north-west was soon discovered to be an entirely distinct series from any Cambrian rocks known in the district, or, indeed, anywhere in Wales, and to be largely made up of volcanic rocks; and the basal Cambrian conglomerate, as marked on the survey-maps, was shown to overlie the granitoid, the quartz-felsite, hälleflinta, and the volcanic schistose and brecciated series unconformably, and to be mainly made up of fragments derived from those series. From the examination of the conglomerates also, it was seen that there were distinct evidences of their having been deposited along old coast-lines, and that their materials varied with the rocks upon which they reposed; also that these pre-Cambrian rocks must have been much in the condition in which they are now found, before the Cambrian conglomerates were deposited upon them. Curiously, also, I found that many of the masses colored as intrusive greenstones on the survey-maps were highly *acid* rocks, and others indurated volcanic ashes of pre-Cambrian age. Indeed, nearly all the so-called intrusive masses marked so abundantly on the survey-map among the older rocks in the St. David's area have been proved beyond doubt to be the result of erroneous observation; and yet we are told by the present director-general that little or no change is required in these maps, and that he

feels it his duty to 'defend the views of his predecessors' as there indicated. There is a still larger area of the Dimetian rocks about ten miles to the east of St. David's: and there, as at St. David's, these granitoid rocks underlie the lowest Cambrian beds without producing the slightest alteration in the latter. Indeed, I have now found no less than six areas in Wales where typical Dimetian granitoid rocks occur under the Cambrian or pre-Cambrian rocks; and in neither of these areas, though several excellent observers have, in addition to myself, searched the boundaries carefully, have we found the slightest indications of their being intrusive in those rocks, though they are all colored as intrusive rocks in the survey-maps. In several of these areas the fact that they must be pre-Cambrian rocks is rendered perfectly certain, as large fragments of the granitoid rocks in exactly the same condition in which they are now found occur in the basal conglomerates of the Cambrian. In one area only, in Wales, have I found Dimetian rocks entirely surrounded by rocks newer than the Cambrian; and here the Llandovery conglomerates and sandstones repose upon them, and are largely made up of materials derived from the Dimetian. In the other areas newer rocks than the Cambrian are found occasionally in contact with limited portions of the Dimetian exposures; but these effects are clearly seen to have been produced by faults.

In his paper to the Geological society, referred to in SCIENCE, Professor Geikie maintained "that the 'Dimetian group' is an eruptive granite which has disrupted and altered the Cambrian strata, even above the horizon of the supposed basal conglomerate." The evidence adduced to support this view was from a section at Ogof-Llesugn, where, as he supposed, "the conglomerate had been torn off and enclosed in the granite, and has been intensely indurated so as to become a sort of pebbly quartzite." Professor Hughes and myself, along with a number of other competent observers, have since examined this spot; and we found that the conglomerate lies quite loosely upon the Dimetian, that at almost every point we could pass our hand between the conglomerate and the granitoid rock, and that the Cambrian conglomerate had no change whatever induced in it beyond that common to it in all parts of the district. Two other sections were mentioned, and drawings exhibited to show the 'Dimetian' intrusive in the Cambrian, and as having eaten deeply into the series at Porthclais. These sections I knew perfectly well, at the time, to be in the lines of faults; but for greater satisfaction I asked Professor Hughes and party to re-examine these with me. The result proved that I was entirely right, and that Professor Geikie and his assistants had mistaken a junction produced by well-marked faulting for an intrusion, and the beds which he supposed had been eaten away had simply been dropped by the fault. He could not produce a single specimen showing contact alteration between the granitoid (Dimetian series) and overlying rocks. His evidence, therefore, fails utterly, on examination; and the pre-Cambrian age of the granitoid rocks of St. David's is rendered, if possible, more than ever certain. An attempt was made to show that the quartz-porphyries which I had pointed out as being intrusive in the Pebidian rocks, which alter the rocks in their immediate vicinity, were just such rocks as might be apophyses of the 'granite,' but, with a curious want of knowledge of the fact that these quartz-porphyries are common to many other parts of the area far distant from the granitoid series, that they also actually in some places cut across the latter.

As Professor Geikie did not spend the time necessary to examine the area where the Arvonian rocks are chiefly exposed, but hastily arrived at the conclusion, without seeing them, that the hälleflintas, breccias, and porcellanites must be intrusive felstones, I need scarcely refer to Professor Geikie's views on this point. I shall refer fully to this question in my paper, in reply, to the Geological society. I may, however, mention, that I exhibited a series of magnificent breccias from this group, and showed large masses of the Cambrian basement conglomerates from Ramsey Island, consisting almost entirely of the rocks of the Arvonian group upon which they repose. The latter are colored in the survey-map as *intrusive* in beds high up in the Silurian (fossiliferous Arenig).

The Pebidian, Professor Geikie says, 'forms an integral part of the Cambrian system.' He acknowledges that it underlies the Cambrian conglomerate, but says the latter rests quite conformably upon the former. In the survey-map these Pebidian beds are supposed to be Cambrian beds higher than the conglomerate, but altered by the so-called intrusions. Here, therefore, some modification of the map is acknowledged to be necessary. Had Professor Geikie and his assistants used ordinary care in examining these conglomerates, they would have seen also that they are constantly in contact with different members of the underlying rocks, that they lie unconformably on the edges of those beds, and also that they are very largely made up of the rocks below.

Professor Geikie did not refer to North Wales in his paper; but as the facts are, if possible, clearer there than in South Wales, I may be allowed to call the attention of the readers of SCIENCE to some sections just published by the Geologists' association of London, preparatory to the visit to be paid by the members to Carnarvonshire and Anglesey, July 23-28. These sections show in a very clear manner how the Cambrian conglomerates creep over the Dimetian, Arvonian, and Pebidian rocks in that area. The rocks of the first two and lowest groups are in that area, as at St. David's, colored as intrusive rocks in the survey-maps, and the last as altered Cambrian and Silurian rocks.

The sections have been prepared by Prof. T. McK. Hughes (Woodwardian professor of geology at Cambridge, and formerly of the Geological survey), who has carefully worked out the geology of this district. He and I were the first to point out, in the year 1877, the similarity of the conditions exhibited here to those at St. David's; and since then he has devoted much time to the elucidation of the facts bearing upon the questions in that area.

In a diagram (no. 1) he shows how the basement conglomerate of the Cambrian, between Bangor and Carnarvon, creeps over no less than four sub-groups of the archean rocks: viz., at Bangor, over the Bryniau beds (Pebidian); at Brithdir, the Dinorwig beds (Arvonian ?); at another part farther south, the Crug beds (upper Dimetian); and at Tut Hill, the Carnarvon beds (lower Dimetian). In section 2, the unconformable overlap of the Cambrian over the Pebidian near Bangor is clearly shown; and in no. 3, a diagram section showing the sequence of the rocks from Carnarvon to Snowdon, the basement beds of the Cambrian are shown rolling over the Carnarvon and Dinorwig groups at different points.

Altogether, the evidence afforded by these sections is of the most conclusive kind; and it seems impossible to believe that the surveyors, when they have seen and examined these sections, and have had more experience with the Welsh rocks, can still cling to the antiquated faith that all these pre-Cambrian rocks

*1.—Diagram plan showing how the Cambrian basement beds creep over the various divisions of the archean between Bangor and Carnarvon (Hughes).*


*Cambrian.*
*b*, Sandstone and shale of Cambrian.
*a*, Conglomerate and grit of Cambrian basement beds.

*Archean.*
*A*, Bryniau beds } Bangor group (= Pebidian, etc.). | *C*, Crug beds } Carnarvon group (= Dimetian).
*B*, Dinorwig beds } | *D*, Twt beds }

*1, Twt Hill; *2, Ysgyborwen; *3, Careggoch; *4, Llandeiniolen; *5, Tymawr; *6, Brithdir; *7, Hendrewen; *8, Bryniau Bangor.

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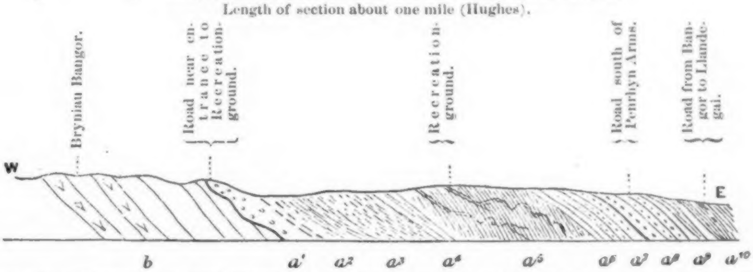
*2.—Diagram section east and west across Bryniau Bangor.*
Length of section about one mile (Hughes).




*b*, Bangor beds (upper Pebidian); $a^1$, Conglomerate and sandstone (basement bed of Cambrian); $a^2$, Sandy mudstone; $a^3$, Finer felspathic mudstone; $a^4$, Pale green felspathic mudstone; $a^5$, Cleaved and contorted felspathic mudstone; $a^6$, Purple and green fine mudstone and slate; $a^7$, Fine sandy flags, like the Bray beds, purple, and here and there green, passing up into brown; $a^8$, Even-bedded thin gray sandstones; $a^9$, Banded flags, passing up into $a^{10}$, Black slates.

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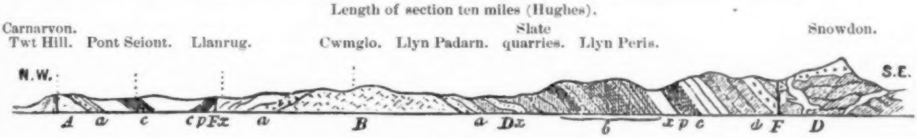
*3.—Diagram section showing the sequence of rocks from Carnarvon to Snowdon.*
Length of section ten miles (Hughes).




*Archean.*
*A*, Carnarvon group (Dimetian); *B*, Dinorwig group.
*a*, Conglomerate and sandstone (basement bed of Cambrian); *b*, Lower and middle portions of Cambrian, not subdivided, but probably including Harlech, Menevian, Lingula flags, and Tremadoc beds; *c*, Arenig; *p*, Pisolitic iron ore; *d*, Bala group, with subordinate volcanic beds; *F*, Faults; *x*, Broken ground; *D*, Dikes.

are merely intrusive masses or altered beds of Silurian and Cambrian age. The basal conglomerate in this area consists in places almost entirely of quartz-felsites, at other points of a mixture of granitoid (true Dimetian) and felsite rocks, and in some cases of schists. I may further mention with regard to the crystalline schists in Anglesey and in Scotland, supposed by the Geological survey also to be of Cambrian and Silurian age, that the recent researches of Bonney, Callaway, Lapworth, and myself, tend to make it certain that they are all, like the similar rocks in America described by Dr. Sterry Hunt and others, of pre-Cambrian age. HENRY HICKS.

Hendon, N. W., London,
July 5, 1883.

## Silurian strata near Winnipeg.

Presuming that it may be of interest to some readers of SCIENCE to read something on the geology of a locality near Winnipeg, I take pleasure in furnishing information, hitherto unpublished, concerning an outcrop of Silurian strata in this part of the north-west. This interesting exposure occurs a short distance from Selkirk, situated some twenty-one miles north of Winnipeg on the Canadian Pacific railway, and near the Red River.

At this place a quarry was opened about a year ago, which, on examination, affords many attractions to a student of science. Fossils belonging to some sixteen species are readily obtained, not only in the

solid rock, but also in the innumerable chippings that lie scattered about the quarry.

The rock is magnesian limestone, dresses readily, and, when burnt, supplies excellent lime. Stone from this place is shipped by rail to Winnipeg, where it is used for ordinary and ornamental building-purposes. Many of the fossils being in the form of casts, they frequently interfere with the successful dressing of the stone. About four feet of drift material overlies the rock; but at another quarry lately opened, nearer the river and a short distance farther north, the drift material attains a thickness of twenty feet. The rock is much the same, but apparently not so fossiliferous.

In the quarry first referred to, the remains of corals belonging to the genera Alveolaria, Halysites, and Zaphrentis, are very numerous. Some specimens obtained bear a close resemblance to the genus Favosites. Another group of very common fossils are representatives of the genera Orthoceras, Endoceras, Ormoceras, and Cyrtoceras.

An excellent specimen measuring eight inches in diameter, with three whorls, was found. The specific characters are much obliterated, but in general outline and appearance it bears a close resemblance to Trocholites ammonius of the Trenton.

Several imperfect specimens of Trilobites were found. One appears to be a member of the genus Illaenus. Fragments of Stromatopora are common, showing in all cases distinct lamination, and, in several, well-defined oscula; while in a few, conical elevations can be observed. The specimens obtained were found among the fragments of rock scattered about the quarry; but the characters of all are exceedingly uniform. The largest obtained measures 7 inches across, 5 in depth, and 2 in thickness. The laminae are well marked, numbering four to the line. They present a wave-like appearance, there being three crests in the section under examination. At the summit of each crest a large aperture is observed. Viewing the specimen from the top, six of these oscula are seen, all about the same distance apart. As yet, I have discovered no rods or pillars present; but there is no question regarding the presence of well-marked laminae and oscula.

I have read carefully the description of the species S. tuberculata, S. perforata, S. granulata, S. mammillata, and S. ostiolata, of Nicholson, and S. concentrica of Goldfuss, and none seem to embrace the species from this quarry. If any reader of SCIENCE can suggest the species to which this interesting fossil from Selkirk belongs, he will confer a great favor upon the writer. J. HOYES PANTON.

### Pre-Bonneville climate.

In a critical notice of my preliminary report on Lake Bonneville (SCIENCE, no. 20), Mr. Davis points out that a certain conclusion as to the history of the basin is not sustained by the phenomena described. Since reading his comment, I have not been able to consult my text; but, if memory serves, his restriction is fully warranted. Still, the conclusion is not of necessity overthrown; for it is based in part on omitted data, the report aiming to present only an outline of the subject. Now that the matter is up for discussion, it may be well to indicate these.

The facts set forth are as follows. Above the Bonneville shore-line the topographic forms are those produced by sub-aerial agencies. Below the shore-line the details are of sub-aqueous origin, but the larger features are sub-aerial in type. Especially are the great alluvial cones constituting the pediments of some of the mountains continued beneath the old water-margin, their surfaces being lightly etched and embossed by lake agencies. Evidently these alluvial cones are of pre-Bonneville date; and evidently, too, the goal of drainage — 'the base level of erosion' — was lower when they were built than during the Bonneville epoch.

The questioned conclusion is, that the emptiness of the basin during the long pre-Bonneville, alluvial-cone epoch was due to aridity. Mr. Davis acutely perceives, that the adduced phenomena comport equally well with the alternative hypothesis that the pre-Bonneville condition of the basin was one of free drainage to the ocean, the present continuity of the basin's rim having been instituted either at or just before the beginning of the Bonneville epoch.

On this hypothesis, the place at which the drainage of the basin was discharged must have acquired the peculiar configuration of a river-channel; and since, as our observations show, alluvial accumulation has not been great in the region during Bonneville and post-Bonneville time, vestiges of this channel should remain. The fact that they have not been found goes far to show that they are not visible; for intelligent search has been made for them, our eyes having been trained for their recognition by the discovery of pre-Bonneville channels *within* the basin. All the low passes of the enclosing rim have been scrutinized. At whatever points, then, earlier drainage systems have intersected this rim, the channels appear to have been obliterated by the erosive and constructive agencies of land sculpture.

Again: the principal plain of the Bonneville basin is at heart mountainous. Its surface is level only because the alluvial mountain bases are deeply buried by later deposits. Of the nature of these deposits we know little more than that the uppermost is lacustrine, the Bonneville layer concealing all else. The deposit representing the pre-Bonneville or alluvial-cone epoch must be relatively heavy, and may be assumed to dominate in the determination of the general configuration of the plain. With the basin closed, a certain system of slopes would arise: with the basin open, there would arise a certain other system, definitely related to the point of discharge. The actual system of slopes is adjusted to the existing status, — a closed basin, with lacustral sedimentation.

Assuming that there was at some remote date a channel of outflow, and that the configuration of the plain was adjusted thereto, the period consumed in the obliteration of the one and the remodelling of the other must have been long as compared with the Bonneville epoch. The pre-Bonneville portion of the period — when the basin was closed, but contained no lake — was presumably characterized by a climate similar to the present.

The aridity of the pre-Bonneville epoch is one of the features associating the Bonneville history with glacial history; for, if it be disproved, the Bonneville flooding no longer demonstrates a climatic episode, and the apparent homology disappears. And the Bonneville oscillations have, of course, no climatographic value if they were orographically produced. It is well, therefore, to test thoroughly every link in the chain of evidence. G. K. GILBERT.

Nevada, July 15, 1883.

## WARD'S DYNAMIC SOCIOLOGY.

### III.

Mr. Ward presents a classification of the sciences differing from those proposed by August Comte and Herbert Spencer. The new classification is of great interest, and deserves especial mention. The classification of Comte was made prior to the great development of modern scientific research, and is imperfect. The classification of Spencer is, like much of his philosophy, a mixture of metaphysical speculation and positive knowledge. Does the classification of Ward meet the requirements of scientific philosophy?

He divides the subject-matter of all science into three parts, which he denominates the 'primary,' 'secondary,' and 'tertiary' aggregations. It is a classification of the objects of the cosmos by modes of aggregation. The primary aggregation is molecular, and gives an inorganic kingdom; the secondary is morphologic, and gives a biologic kingdom; the tertiary is sociologic, and is represented by human society.

A mountain is an aggregation of rocks, or geological formations, some of which may be crystalline, others detrital. It is an inorganic molar aggregate, and must fall into Mr. Ward's first class. But the earth itself is an aggregate of solids, fluids, and gases. Its solids are molar aggregates of detrital and crystalline rocks. These rocks at the surface are arranged in mountains, hills, and valleys, with intervening depressions filled with bodies of water, — seas, lakes, and rivers; and beneath, an unknown interior; and above, the atmosphere. The atmosphere is in motion. The water is carried into the air, and moves with it, and descends again upon the earth. The known solid portion of the earth is also in motion, rising and falling in its relation to the centre of the earth; while portions of the unknown interior of the earth are, by extravasation, coming to the surface, and the land portions of the earth are being carried by the waters into the sea.

Geology teaches us, then, that the earth is composed of interdependent parts; that the circulation of the air, of the waters, of the solids, and of the interior liquids is carried on by the action of the several interdependent parts; and the earth has been not inaptly compared by eminent geologists to a living or organized being. If we properly understand Mr. Ward, this aggregation also is to be relegated to his first class.

Again: the earth is one of a group of worlds composing the solar system, — the solar aggregation, composed of interdependent parts; and this aggregation is also to be included in the first class.

The inclusion of all of these modes of aggregation in the one class is tacit. He does not clearly set them forth, and his definitions are imperfect. It is difficult to understand from his discussion whether they were considered in his general scheme, or whether he would, if considering them, establish one or two more grand categories.

Again: psychology is included in the secondary aggregation as belonging to biology. As the term is now used by scientific men, 'psychology' includes a consideration of the biologic organ of the mind and its operations. Through these operations are produced languages, giving the science of philology; arts, giving the science of technology; societies, giving the science of sociology; and opinions, giving the science of philosophy. With Mr. Ward, philology, technology, and perhaps philosophy, are subordinate parts of sociology. Though he does not make direct statement to this effect, yet his presentation leads to this conclusion, in the same manner as his presentation of the subject of primary aggregation leads to the supposition that he intends to include molar and stellar aggregations therein.

Psychology has its biologic organ in the brain and nervous system; and mind is discovered in the lower orders of life, as well as in man. The genesis of psychology is manifestly in biology. In like manner, the organs of speech, active and passive, alike in oral, sign, and written language, are biologic; and language is also found in the lower orders of life. Language, therefore, has its genesis in biology. In the same manner, the organs of the arts are biologic; and rude arts are discovered in the lower orders of life. Technology, therefore, has its genesis in biology. The first step in sociologic organization is the biologic differentiation of the sexes, giving husband and wife, parent and child; and rude social organization is also found in the lower orders of life. Sociology, therefore, has its genesis in biology. The same considerations that would lead to the relegation of psychology to biology would also lead to the inclusion of philology, technology, and sociology, and perhaps of philosophy.

Now, these five sciences are so bound together that the absence of one would void all. They are interdependent anp co-ordinate in such a manner that the evolution of one is dependent on the evolution of all. Language is a means of communication between individ-

ual minds. Discrete minds could not develop language: it is produced by many co-existing individuals of each of a long series of generations. Society and mind were necessary to its production. The arts are produced by many persons in the same manner as languages, and involve also the operations of mind; but the arts could not have been developed without the concomitant development of language, for art is built on art, and that which remains in art must pass from person to person and from generation to generation by means of language. The arts of absolutely discrete men could make no progress.

For the evolution of society, language is necessary for the intercommunication of thought. The interdependence of men as integral parts of bodies politic would be impossible without language; and sociologic organization is dependent upon the differentiation of human activities, or the division of labor, and is therefore dependent upon the development of arts or technology. Philosophy, or the science of evolving opinion, is the final product of the mind, and is therefore dependent upon psychologic evolution. It is dependent upon philology, for language is the mould of thought, and determines its form. It is dependent upon technology, for by the arts men reach knowledge not otherwise attainable; and upon sociology, for it is the combined knowledge of many, accumulating through the generations.

Again: all that part of the evolution of psychology which distinguishes the human mind from that of the lower animals is due to the tertiary aggregation in the development of philology, technology, sociology, and philosophy. In philology the method of evolution is the survival of the economic in the struggle for expression; and the course of evolution is through the specialization of the grammatic processes, the differentiation of the parts of speech, and the integration of the sentence. The method of evolution in technology is the survival of the useful in the struggle to have; and the course of evolution is the employment of the forces and materials of nature for the benefit of mankind. The method of sociologic evolution is the survival of justice in the struggle for peace; and the course of evolution is the differentiation of the functions and organs of government, and the integration of tribes and nations. The method of evolution in philosophy is the survival of the true in the struggle to know; and the course of evolution is in the discernment and discrimination of phenomena, the relegation from analogic to homologic categories in classification, and the discovery of more and more complex sequences. In these psychologic sciences the struggle, i.e., the endeavor, i.e., the conation, is teleologic.

The primary method of psychologic evolution is the survival of the fittest in the struggle for existence, and is purely biologic. The struggling subject itself survives. The secondary or indirect method of psychologic evolution is by the agencies of the philologic, technologic, sociologic, and philosophic methods; and, combined, they constitute the successful struggle for happiness. All that part of the evolution of psychology which separates man from the lower animals is due to this secondary or indirect method, and is teleologic; and progress is due, not to the survival of the fittest of the struggling subjects, but to the survival of the object for which the struggle is made. These five sciences, therefore, constitute one group, through the fact that they belong properly to the tertiary aggregation of matter, and the further fact that the method or cause of evolution exhibited therein is radically different from the method or cause of evolution in biology. The five sciences are co-ordinate, reciprocal, and interdependent. As biology has its genesis through protoplasm and organic chemistry in the physical aggregation, so these five sciences of the tertiary aggregation have their genesis in biology, — in the biologic organs of mankind, and the beginnings of these sciences discovered among the lower animals.

Elsewhere Mr. Ward classifies phenomena in the manner shown in the table on the following page, which is copied from his work.

Of the four groups thus derived, the first, inorganic, corresponds to the group embraced in his primary aggregation; the second, organic, to the group embraced in his secondary aggregation, but excludes psychology, philology, technology, sociology, and philosophy. If we combine his direct and indirect teleologic phenomena into one group, the five great sciences which include the operations and products of the mind are thrown into one. Let the first, then, be called *physical phenomena* or phenomena of the primary aggregation, and the sciences which pertain thereto physical sciences; the second, *biologic phenomena* or phenomena of the secondary aggregation, and the sciences pertaining thereto biologic sciences. But what shall the third group be called? If the term psychology is used, it must be with a wider connoting than that which it has heretofore had. Psychology.

*Phenomena are:*

Genetic; physical; unconscious: producing change through infinitesimal increments.

*Inorganic:* the result of physical or mechanical forces.

*Organic:* the result of vital or biological forces.

Teleological; psychical; conscious: proceeding from volition and involving purpose.

*Direct:* proceeding according to the direct method of conation.

*Indirect:* proceeding according to the indirect method of conation.

*Zoölogical:* as manifested by creatures below man.

*Anthropological:* as manifested by man. Domain of the social forces.

*Natural:* taking place according to uniform laws, and produced by true natural forces; capable of prediction and modification.

*Artificial:* consisting of natural phenomena modified by the inventive faculty.

then, would include the operations of the mind, and the products, or results, of those operations. If we use anthropology, the term will not include the beginnings of psychology, philology, technology, and sociology, found among the lower animals; for they have mind, language, art, and society in a comparatively low form. On the other hand, anthropology has been used so as to include the biology of man. If we use sociology, following Comte, Spencer, and Ward, the term must include more than these authors design, and some other term must be selected for that differentiated science which forms one of the group of five, and which above has been designated as sociology. Altogether it seems better to use the term *anthropology*, which would then include psychology, philology, technology, sociology, and philosophy.

Mr. Ward does not relegate ethics to any place in his scheme. Moral science relates to that portion of human conduct in which the qualities of right and wrong inhere; and the moral quality depends upon the relations which exist between men and men: it is therefore a part of sociology; and the principal body of ethics at any time existing among a people is formulated as law, made by the court or the legislature. Mr. Spencer, in his essay on the classification of the sciences, gives it no place, but, in the elaborate scheme of philosophy embraced in his works, places it above sociology.

It may be asked, What place does logic take in the classification here proposed? The reply is, that the logic of the ancients has no place in science. To modern logic something else has been added; and this something else belongs to psychology. The logic of the ancients, and a large part of that of modern metaphysicians, is a system designed to discover truth by a form of words. If it be truthfully asserted that an object is white, no form of words can prove the truth of the assertion. If questioned, the questioner must perceive that the body is white in the same manner as it was perceived by the person making the assertion; and the assertor can only point out, i.e., demonstrate, the fact. And the same is true of any other fact, howsoever simple or complex. A truth or fact can be pointed out or demonstrated to the eye, or to the mind's eye, but cannot be proved by a logical form of statement. The idea of logical proof is a conception of a time when powers were occult; and logic divested of modern appurtenances is an occult art.

It would make this article too long to attempt to set forth fully the place of mathematics in this scheme; but quantitative relations, like qualitative relations, belong to all degrees of aggregations, to all complexities of phenomena, and to all stages of evolution; and, in the science of mathematics, relations of quantity are considered apart from other relations, and in the abstract.

Mr. Spencer, although he presents a classification of the sciences, does not use it in his philosophy of evolution, but practically uses the primary classification here set forth, under the terms 'inorganic,' 'organic,' and 'superorganic' evolution.

The defect in Mr. Ward's classification here pointed out seriously influences his presentation of the subject of dynamic sociology proper, appearing in the second volume. It also greatly narrows his view of the field of successful endeavor for organized society. Mankind has made progress, i.e., secured happiness, quite as much by the effort for peace and the establishment of justice as by the effort to know and the acquisition of truth. It can be shown in other and diverse ways that his view of successful human endeavor is

philosophically narrow; and he sometimes uses the epithets of the pessimist in a manner unworthy the philosopher.

## FRUIT-INSECTS.

*Insects injurious to fruits.* Illustrated with 440 cuts. By WILLIAM SAUNDERS. Philadelphia, *Lippincott*, 1883. 436 p. 8°.

THE author has enjoyed exceptional advantages for the preparation of the work he has undertaken. Not only has he been acquainted with the work of economic entomologists through his own participation in it, and as editor of one of our principal entomological periodicals, but for twenty years past he has been an extensive fruit-grower as well. He is thus entirely familiar with what is wanted, and has produced a practical book of considerable value. Not that it contains much that is original or of novel presentment: it is rather a plain and judicious statement of what is known, but accessible to few because scattered in periodical literature. One is surprised at the size of the book when he sees that no effort is made to fill it out with unnecessary matter: rarely are half a dozen pages given to any one insect, and more than two hundred and fifty harmful insects are discussed.

The insects are treated under the head of the plants they affect and the parts of the plant they attack, — an excellent method, first used in this country by Fitch. They are described in brief, untechnical language, almost invariably figured, and often in several stages; and the account of their injuries is followed by a short statement of the best remedies, with illustrations of the parasites or other natural foes which keep the insects more or less in check. The plants which receive most attention are the apple (64 insects, 127 pages), the grape (52 insects, 75 pages), and the orange (26 insects, 45 pages). Next after these in importance are the plum, pear, the various currants, the raspberry, and the strawberry, followed at a little distance by the peach; a few pages each suffice for the cherry, quince, gooseberry, melon, cranberry, olive, and fig.

The illustrations are familiar friends to entomologists, almost all of them having already done abundant service; but they are none the less valuable for the purpose of this work; and the paper on which they are now printed permits to many of them a respectability they must rejoice to attain after long familiarity with the crude workmanship of the various government presses under which they have been tortured. With a little more care in the printing, they would have shown at their best.

The only serious omission in the book is the absence of a systematic summary, or index, by which the insects of the same group attacking different plants should be brought together. This would the more readily serve to help the fruit-grower distinguish allied forms, and learn their different or similar habits. Such an index could have been so easily constructed, and would have occupied so little space, that its absence is the less excusable.

## BREMIKER'S LOGARITHMIC TABLES.

*Bremiker's Logarithmisch-trigonometrische tafeln mit sechs decimal-stellen.* Neu bearbeitet von Dr. TH. ALBRECHT, professor and chief of section in the Royal Prussian geodetic institute. Tenth stereotype edition. Berlin, *R. Stricker*, 1883. 18+598 p. 8°.

BREMIKER'S six-figure logarithms were first published in 1852 with a Latin text and title: Nova tabula Berolinensis, etc. In 1860 a German edition was printed. Both these editions were printed from movable types. In 1869 a stereotyped edition was printed, with some changes in the contents of the work. The editions of 1852 and 1860 contained a capital table of the sines and tangents of small arcs, which was omitted in the stereotype edition; and in this latter edition a table of addition and subtraction logarithms was introduced. The omission of the table of the functions of small arcs was hardly an improvement; and, in fact, this omission caused the early editions to command a higher price than the later stereotyped one.

The present edition by Dr. Albrecht combines the excellences of both the preceding editions. It contains the table of the logarithmic sines and logarithmic tangents of arcs up to 5° for each 1″, and also includes the addition and subtraction tables.

The rest of the work is the same as the stereotype edition of 1869, except that four new pages of convenient constant logarithms are inserted, and that certain tables relating to units of weight and measure are omitted.

This collection of tables is a very practical and valuable addition to our present means of computation, and it will be welcomed as such. In the opinion of the writer, it is also the most satisfactory single collection of tables for students' use, although much can be said in favor of the best of the five-place tables for this purpose.

EDWARD S. HOLDEN.

# WEEKLY SUMMARY OF THE PROGRESS OF SCIENCE.

## ASTRONOMY.

**Astrophysical observations of Jupiter.** — Ricco publishes a fine series of eighteen drawings of the planet, made, with one exception, in 1881, 1882, and 1883, by means of the ten-inch telescope of the observatory of Palermo. He gives, also, a large number of micrometrical measures, and detailed descriptions of the appearance of the planet and its surface-markings, on forty-seven different dates. The effect of the 'red spot' upon the contour of the adjacent belts is well brought out. — (*Mem. soc. spettr. ital.*, May, 1883.) C. A. Y. [172

**Photometric observations of eclipses of Jupiter's satellites.** — Cornu and Obrecht give the results of some experiments upon artificial eclipses made to imitate the eclipses of Jupiter's satellites, using the method already referred to in these columns. They find that the probable error in determining the time when the light of the satellite is reduced to one-half its normal amount is about a hundredth of the total time of obscuration. They propose, also, the use of a polariscopic arrangement in place of the 'cat's-eye,' and, in this connection, append the following note: "We have recently learned that the astronomers of Harvard college employ an analogous arrangement — of which, however, the description is not known to us — for the purpose of determining the moment of disappearance (*pour arriver à définir l'époque de l'éclat nul*). If the apparatus is analogous, the method of observation is, as one sees, entirely different." They have evidently been misinformed; for the very essence of Prof. Pickering's plan consists in the determination, not of the moment of disappearance, but of half-brightness. — (*Comptes rendus*, June 25, 1883.) C. A. Y. [173

## MATHEMATICS.

**Surfaces of constant curvature.** — M. Weingarten here deals with certain properties of the linear elements on surfaces with a constant measure of curvature. Certain considerations connected with the modern theory of functions, particularly that portion of the theory which deals with linear differential equations of the second order, have led him to conjecture that the determination of the geodetic lines upon a surface of constant curvature, by means of certain given linear elements, stands in a close relation to the theory of the linear differential equations of the second order. M. Weingarten makes the remark (which, though not new, is important here) that the extension of those properties of curved surfaces, studied and enunciated by Gauss, which depend upon a given form of the linear element, is much simplified by the introduction of certain functions of the position of a point upon the surface. The values of these functions are given in terms of the coefficients of the linear element in such a way, that, by the introduction of new (two) variables, we arrive again at the original linear element. The functions possessing this (invariantive) property are called flexion-invariants (*biegungsinvarianten*). As an example of flexion-invariants, we have the 'measure of curvature' of a surface. From the differential coefficients of a flexion-invariant, and the Gaussian coefficients, $E$, $F$, $G$, of a linear element of a surface, an indefinite number of new invariants can be formed, two only of which are independent. The author gives a brief account of Beltrami's work on these functions, and then considers particularly the surfaces of constant curvature. The paper is an exceedingly interesting one to the student of this particular branch of geometry, and is a valuable addition to the previous memoirs, by M. Weingarten, on this and cognate subjects. — (*Journ. reine ang. math.*, 1883.) T. C. [174

## PHYSICS.

**Density of the earth.** — Major R. v. Sterneck of the government Military-geographical institute of Vienna, last year, tried Airy's method of the determination of the earth's mean density in the St. Adalbert shaft of the silver-mines at Přibram, Bohemia, at depths of 516 and 972.5 metres. His average result was 5.65, which agrees closely with the values determined by other methods. On comparing his measures with Airy's, a curious agreement appears in the number of seconds gained by a clock at different depths, and a continual decrease in the deduced mean density as the depth increases. Airy found (1854), at a depth of 383 metres, that his clock gained $2^s.25$ a day, and the density was 6.57; v. Sterneck's figures are 516, $2^s.4$, and 6.28, and 972, $2^s.3$, 5.01, respectively: whence he concludes, "that, in the interior of the earth, the resultant of gravity, centrifugal force, and the attraction of the superincumbent mass, is constant." — (*Mitth. k.-k. milit.-geogr. inst. Wien*, 1882, ii. 77.) W. M. D. [175

### Electricity.

**Geographical variation of horizontal intensity.** — F. Kohlrausch proposes to use a form of his local-variometer (described in *Ann. phys. chem.*, xviii. 545) in which the scale is at a distance $A$ from the axis of suspension, and attached to the instrument, and obtains between the horizontal intensities at two different places the relation —

$$\frac{H' - H}{H} = \frac{\tan \phi}{4A}(n' - n) + \mu(t - t');$$

$\phi$ being the angle through which the frame of the instrument is turned, $n$ and $n'$ the deflections in scale-divisions, and $\mu$ a coefficient of the temperature, $t$. — (*Ann. phys. chem.*, xix. 130.) J. T. [176

**Thermochemical properties of electromotive force.** — Edlund investigates the thermal changes at the electrodes of a voltameter by placing the junctions of a thermopile in front of the electrodes, and enclosing both in a porous membrane. He finds, that, when the electrodes are copper and the liquid copper sulphate, the electromotive force between the metal and the liquid uses less heat for formation of current than is set free in the formation of copper sulphate.

The same law holds for zinc and zinc sulphate, cadmium with its acetate, and lead with its acetate; but for silver, with its sulphate, nitrate, and acetate, the law is reversed. In a Daniell cell, *a fortiori*, less heat is used for formation of current than is set free in the chemical action of the cell. — (*Ann. phys. chem.*, xix. 287.) J. T. [177

## CHEMISTRY.

(*General, physical, and inorganic.*)

**Speed of dissociation of brass.** — Mr. E. Twitchell (under Prof. Robert B. Warder's direction) made the following determinations, which were suggested by Bobierre's method for the separation of copper and zinc in alloys. A piece of brass wire (no. 17) 150 mm. long and 1.43 mm. in diameter was heated to redness in a stream of hydrogen in a porcelain tube. The loss in weight, from hour to hour, is given in the following table: —

| Time in hours. | Weight of alloy. | Loss per hour. | Zinc present. | A. |
|---|---|---|---|---|
| 0 | 2.0570 | | .7409 | |
| 1 | 1 9128 | .1442 | .5967 | 92 |
| 2 | 1.8527 | .0601 | .5366 | 70 |
| 3 | 1.7855 | .0672 | .4694 | 66 |
| 4 | 1.7418 | .0437 | .4257 | 60 |
| 5 | 1.7168 | .0250 | .4007 | 53 |
| 6 | 1.6957 | .0211 | .3796 | 48 |
| 9 | 1 6624 | .0111 | .3463 | 37 |
| 12 | 1.6339 | .0095 | .3178 | 31 |

The figures given under A are proportional to the 'coefficient of speed,' as calculated from each observation, on the hypothesis that the zinc expelled at each moment is proportional to the whole quantity of zinc present. The steady decrease in the last column shows that this hypothesis does not obtain under the conditions of the experiment, but that an appreciable interval of time is required for the transfer of zinc from the central portion to the surface of the wire. Further experiments upon this *diffusion* of zinc are in progress. — (*Sect. chem. phys. Ohio mech. inst.; meeting* May 31.) [178

## AGRICULTURE.

**Influence of temperature and rainfall on the wheat-crop.** — A comparison of the average temperature and the rainfall in England during the months of July and August for the last thirty-six years, with the corresponding wheat-crop, justifies the following conclusions: provided the stand of the crop at the beginning of July is promising, a temperature above the average for the succeeding two months insures more than an average crop as regards quantity, unless extraordinary circumstances, such as violent storms, intervene. Rainy weather may reduce the quality of the crop. On the other hand, however promising the crop may be at the end of June, a temperature below the average in July and August involves a small crop. If the weather is clear, the quality may be good, while, if cold and rain are united, the poorest crops are the result; such as those of 1879, when the temperature was 2.8° F. below the average, and the rainfall four inches above the average, or that of 1816 (the poorest crop on record), when the temperature was 4.8° F. below the average. — (*Bied. centr.-blatt.*, xii. 291.) H. P. A. [179

**Effect of phosphatic manures in drought.** — In the course of some field-experiments made during the very dry season of 1881, Emmerling observed that in one case manuring with ammonia alone produced a greater gain than manuring with ammonia and superphosphate. The result may have been accidental, as no duplicate trials seem to have been made; but Emmerling thinks that the manuring with phosphoric acid hastened the ripening of the plants, while the ammonia had the opposite effect of postponing the ripening, and keeping the plants green longer. (This effect of phosphoric acid has been observed in water-culture experiments, and silica also seems to exert a similar action.) — (*Bied. centr.-blatt.*, xii. 297.) H. P. A. [180

**Damage to grain by wetting.** — Märcker has examined a sample of barley which had been exposed to rain for fourteen days after it was cut. A considerable proportion of the starch had been converted into sugar. A loss of about six per cent of starch took place. The albuminoids were also altered, both the insoluble and soluble proteine having been partially converted into amides. The proportion of seed capable of germination was reduced from ninety-eight per cent to forty-five per cent. Kobus obtained similar results in an examination of damaged wheat. — (*Bied. centr.-blatt.*, xii. 326.) H. P. A. [181

## MINERALOGY.

**Enclosures in muscovite.** — The occurrence of biotite and muscovite in one crystal is well known, and has been investigated by H. Carvill Lewis. He prepared cleavage-sections from one specimen, and arranged them in the order in which they occurred. The biotite contrasts strongly with the light-colored muscovite, and has often well-defined edges. The two micas are arranged symmetrically in relation to their prismatic planes, as may be shown by the crystal edges when they are well developed, or by the strike-figures which are parallel in the two micas in the same folia, making it probable that they have crystallized together out of the same solution. In examining a series of sections from one specimen, it is found that the proportion of the two micas varies in different parts of the crystal; the biotite, the more unstable of the two species, gradually giving way, and being changed into the more hardy muscovite.

Of a different nature are the superficial markings of magnetite, which occur from various localities. These markings form a series of branching lines, which run in three directions across the plates of the mica, crossing each other at angles of 60°, and have been regarded as repeated twinning around a dodecahedral axis. These lines, however, as shown by the author, bear a fixed relation to the axes of the mica, and are not due to any inherent property of the magnetite. If a crystal showing these markings be dissected, the lines of marking will all be found to lie in parallel direction; nor is there any direct connection

with the markings on adjacent plates: one may be covered by the markings, the next free from them. The magnetite does not penetrate, but lies superficially upon the mica plates, and the lines follow the direction of the rays of the strike-figure. The author regards the magnetite as not derived from any external source, but from the muscovite itself, occurring, not along cracks or near the exterior of the crystals, but grouped in the interior of the same. — (*Proc. acad. nat. sc. Philad.*, Dec., 1882.) S. L. P. [182

## GEOGRAPHY.

*(Europe.)*

**Deformation of the earth's surface.** — J. Girard calls attention to some interesting observations on apparent changes of level of neighboring points. One account attested by Girardet (*Exploration*, June, 1882) is of villages in the Jura which were hidden from each other at the beginning of the century, or even only forty years ago, but are now in sight. First the roofs, and later the walls, became visible by the slow warping of the ground. Another example is recorded in Bohemia, about thirty miles south of Karlsbad, where the people of Hohen Zedlisch are convinced that their village is rising; for thirty years ago they could see only the top of the church-spire in Ottenreuth, while now more than half of it is in view, and some roofs of lower buildings have also risen into sight. A line of levels has been run here to detect any further changes (*Congres sc. géogr.*, 1875). Girard does not attempt any criticism of these statements, but accepts them as proved. There would seem to be room for other explanations than the one suggested. — (*Rev. de géogr.*, 1883, 349.) W. M. D. [183

**Maps of Norway.** — The Norwegian geographical survey (Geografiske opmaaling) has published maps as follows: a guide-map, showing the progress of triangulation from 1779 to 1876 (only a small part of this work remains unfinished), — based upon this are several topographic maps on various scales; for the southern part of the country some are even 1 : 50,000 (or 1 : 10,000), in many sheets; the general map of southern Norway (1 : 400,000), in eighteen sheets; district-maps (1 : 200,000); and rectangle-maps (1 : 100,000), in fifty-four sections, with contours and mountain shading, and the larger bodies of water in blue. This serves as a basis for the geological survey under Prof. Th. Kjerulf. A general geological map (1 : 1,000,000) is also published. The coast-survey publishes charts of the southern shores on 1 : 50,000; of the northern, on 1 : 100,000. Thirty-two of the former and thirteen of the latter are completed. Besides these, there are a general coast-map (1 : 200,000) in thirteen sheets, and another on a smaller scale in five sheets, and fishery-maps (1 : 100,000) in eleven sheets. — (*Mitth. geogr. ges. Wien*, xxvi. 1883, 190.) W. M. D. [184

**The Bavarian forest.** — The physical features of this submountainous district, extending north of the Danube below Regensburg, are described under its topography and geology by Dr. C. W. von Gümbel, and its climatic relations by Dr. Ebermayer. The article is hardly susceptible of concentration, and we reproduce only what is said concerning the glaciation of the higher ground contemporaneous with that of the Alps. It is admitted that the diluvial deposits do not point with distinctness to glacial action, that striations and moraine-walls can hardly be recognized, and that the characteristic morainic landscape, so pronounced near the adjacent Alps, is absent here; but the numerous small lakes in the higher parts of the country (Arber-, Rachel-, Bestritzer-, Girgl-See and others), and the plentiful peat-swamps, the remains of extinct water-basins, are accepted as evidence of former glaciation. Among all the lakes, there is not one which cannot be explained as resulting either from local glacial erosion, or from obstruction of old valleys by drift-deposits. — (*Deutsche geogr. blätter*, vi. 1883, 21.) W. M. D. [185

*(Asia.)*

**Telegraph-line in China.** — Since the destruction of the short railroad from Shanghai to Wusung by the Chinese shortly after its building in 1877, it has been thought that there would be opposition to further introduction of foreign contrivances; and two years ago, when the construction of a telegraph-line was begun between Shanghai and Tientsin, a party of soldiers was detailed to guard the foreign engineers employed on it. The caution proved unnecessary: and the chief difficulties encountered were the numerous canals, some of which had to be crossed by cables. The want of good roads was a serious embarrassment when the line ran at a distance from the grand canal. The line is 938 miles in length, and required nearly twenty thousand poles. The construction was begun in June, 1881, at the two termini, and in December was opened to public use. — (*Pet. geogr. mitth.*, 1883, 231.) W. M. D. [186

**Explorations in Cambodia.** — Dr. Néis announces his arrival in Laos, on the border of Siam. From Sambok to Sombor the Mekong River is a continuous series of rapids, passable only for the native canoes. Thence above to Laos the left bank is encumbered with shoals. The country is chiefly covered with forests, which, along the river, are infested by Chinese pirates, who render river-traffic between Laos and Cambodia very limited. Laos contains some two hundred houses, and two thousand inhabitants, — Laotians and Chinese, who raise cotton and rice. The commerce is small, iron money is in use, and the Chinese are the chief traders. The ruins described by Garnier, to examine which was the chief object of the expedition, were visited. No inscriptions were found, and but a few interesting carvings. A sort of oven was filled with thousands of pieces of bark stamped, like medals, with three figures of Buddha: some retained traces of color and gilding. Some statuettes of Buddha of *faience* were found in a vessel embedded in the cement of the oven. Dr. Néis found the fauna of Laos essentially the same as that of Cambodia. He intended, at the date of writing, to penetrate as far as Bassak, in Siam, where he would endeavor to obtain as complete collections as possible. — (*Comptes rendus soc. géogr.*, no. 11.) W. H. D. [187

## BOTANY.

**Influence of diminished atmospheric pressure on the growth of plants.** — Experiments conducted by Wieler at Tübingen show, that, all other external conditions being the same, plants will grow more rapidly under *diminished* atmospheric pressure. Thus, if a specimen of the common Windsor bean (Vicia faba) be grown in a receptacle in which the pressure of the air can be controlled, it will be found to grow faster until the pressure has been diminished to 100-300 mm.; the normal pressure under which the ancestors of the plant have flourished being, of course, not far from 760 mm. If, however, the pressure is reduced below the smaller figure given above, the rate of growth diminishes. Wieler found that the curve of growth of the sunflower is about the same as that of the bean. It was further shown by his experiments, that growth is retarded by increased pressure until the minimum is reached at 2-2½ atmospheres, from which point there is again an increase. Although the short abstract of these interesting results so far published is meagre in the extreme, it indicates that the field entered upon by Wieler (and by Bert in France) may compel us to revise some notions now held in regard to the adaptation of plants to their surroundings in past ages, and at the present time upon high mountains. — (*Botan. zeit.*, July 6.) G. L. G. [188

**Pollination of Cypella.** — Two Brazilian species of this genus of Irideae have been studied from time to time by Fritz Müller, who finds a number of interesting peculiarities in their flowering. The flowers, like those of Cordia, etc., are produced in abundance only on certain days, which recur more or less regularly, and apparently independently of climatic conditions. Nectar is secreted in pockets on the three petals, which are flexible, so that when a Xylocopa or Bombus, to which the flowers seem well adapted, alights on one in quest of nectar, it bends over with the weight of the bee, whose back is brought in contact with a stigma and the underlying anther. Commonly the bee goes immediately to another flower without trying the other petals of the one on which it has first settled, so that crossing is effected by it. One of the species studied proves to have self-impotent pollen: the other is fertile with its own pollen. The stingless bees (Trigona), though not necessarily excluded by structural peculiarities from the nectar, do not obtain it readily; yet their visits for the protectively colored (pale-bluish) pollen are sufficiently numerous to prevent the larger bees from visiting the flowers in numbers. — (*Berichte deutsch. bot. gesellsch.*, April 3, 1883.) W. T. [189

## ZOÖLOGY.

*(General physiology and embryology.)*

**Influence of gravity on cell-division.** — E. Pflüger, by placing fresh laid frogs' eggs in a watch-glass, and adding a little water with semen, and pouring it off in a few seconds, was able to impregnate the eggs without allowing the gelatinous envelopes time to swell. The eggs then adhered to the glass, and so could be brought into various positions. The first division occurs in three hours, and always in a vertical plane, no matter how the axis of the egg lies. When the axis of the egg (from dark to white pole) lies horizontally, the plane of division is still always vertical, but may form any angle with the ovic axis. The influence of gravity is also shown in that the upper pole divides more rapidly than the lower. If the position of the egg is exactly reversed, this still holds true, and development progresses; so that repeatedly the medullary furrow, with its high bordering ridges (nervous system), was found upon the *white* side when this was uppermost. Out of seventeen eggs, twelve developed so that the median plane of the body of the embryo coincided with that of the first division of the yolk. (This fact of a relation between the lines of cleavage and the axes of body is not novel, as Pflüger seems to think: there are many observations on various animals which prove such a relation.) From these experiments it results that the topography of the organs is not determined by the arrangement of the substance around the axes of the egg, but that the axis around which the organs are grouped is determined by gravity. — (*Pflüger's arch. physiol.*, xxxi. 311.) C. S. M. [190

### Mammals.

**Germ-layers of rodents.** — A. Fraser finds in the common gray rat and the house mouse the same arrangement of the layers as in the guinea-pig. The *decidua* appears to differ in the mode of its formation from that which ordinarily obtains; and the very early, rapid, and voluminous formation of its solid mass appears to have some close and constant relation to the peculiar inversion of the blastodermic layers which is found in these rodents. — (*Journ. roy. micr. soc. Lond.*, June, 1883, 345.) C. S. M. [191

**Intestinal absorption of fat by lymph-cells.** — Zawarykin has studied the small intestine during active digestion, making sections stained with perosmic acid and picrocarmine. The material was obtained from dogs, rabbits, and white rats. The lymph-cells are found between the epithelial cells covering the follicle and in the underlying adenoid tissue, and finally in the mouths of the chylous vessels. These cells alone contain any fat, being charged with globules of various sizes. Their multifarious irregular forms, and the inconstant shape of the nucleus, indicate that they were performing active amoeboid movements when fixed by the osmic acid. From these appearances Zawarykin concludes that the lymph-cells (leucocytes) resorb the fat: they enter the epithelium, seize the particles of fat by amoeboid movements, then descend between the cylinder-cells, through the sub-epithelial endothelium and adenoid tissue, into the roots of the chylous vessels. In Peyer's patches the cells are present in crowds, and the resorption of fat seems particularly active at those points. (The presence of lymph-cells between the epithelial cells of the intestines has been known for some time, but the significance of their occurrence has not been heretofore understood. Sewall advanced the view that the immigrant cells remain and become epithelial cells; but that appeared highly

improbable. The manner in which fat is absorbed has been much discussed of late years, but the explanation given by Prof. Zawarykin appears to us the first satisfactory one which has been offered.)—(*Pflüger's arch. physiol.*, xxxi. 231.) C. S. M. [192

## ANTHROPOLOGY.

**Brain-weight of boys and girls.**—In the final result of the comparison of the two sexes in the human race, anatomical researches will form an important factor. Many anatomists have recognized this fact, and have instituted comparisons between the sexes from various points of view. M. Gustave le Bon reviews the work of M. Manouvrier and that of M. Budin, both of whom aver that "sex has no influence on brain-weight. With them the influence of sex is nothing more than the influence of height; and if the females as a whole exceed the males in brain-weight, it is simply because the weight of the body in the females is much below that of the males." M. le Bon puts the theory of his adversaries to the test in a very ingenious manner by comparing the brains of males and females having about the same weight. By this investigation it is shown that in the great majority of cases the male children surpass the females of the same weight in their cranial circumference. At the same age, height, and weight of body, the female brain is notably smaller than that of the male.—(*Bull. soc. anthrop. Paris*, v. 524-531.) J. W. P. [193

**The Galibis.**—The tribe of Galibis lives on the borders of the Sinamari, and not far from Cayenne, in French Guiana, and it consists of only a few families. A group of fifteen of them were sent to Paris in 1882; and several gentlemen, among them Mr. Manouvrier, have undertaken to study their physique, customs, language, etc. The Galibis were domiciled in their native fashion in the *jardin d'acclimatation*, and passed their time in their ordinary pursuits. The skin is reddish brown, but differs with individuals, owing partly to mixed blood: the true color is also disguised by the use of paint. The hair and eyes are jet black. The other physical characters, as well as their language and occupations, are given with the greatest minuteness. A single observation will show the extreme caution with which fine theories should be spun. M. Capitan studied carefully the processes of making pottery among the Galibis. Hamy took occasion to remark upon this as upon the greater rudeness of ornamentation in other respects, and concluded that the Galibis had much degenerated since they were first studied. But Mortillet recalled the discussion to a sober view by remarking that the specimens in our museums are choice objects, selected by travellers for their great beauty, while those made by the Galibis in the jardin were by rude workmen for daily use. They show us the cabin of the poor, while the voyagers had despoiled the homes of the rich. Theories of degeneration based upon Hamy's facts were therefore unsubstantial.—(*Bull. soc. anthrop. Paris*, v. 602.) J. W. P. [194

**African psychology.**—Max Buchner, writing to *Ausland*, speaks rather encouragingly of the Bantu negro character. "The negro in his native condition is not apparently of a lower grade of natural intelligence than the European of the common class. He probably excels the European in a kind of selfish cunning, while the restraints of moral scruples and of the finer feelings operate less strongly upon him. Yet he is not destitute of a sort of moral instinct, a kind of taboo conscience, that causes him to hesitate to do wrong. For this reason the negro is never an open thief." Mr. Jefferson used to say that his slaves were all honest, but they could beat the world finding things. The negro, says Buchner, is above every thing positivist, practical, materialist, and is inaccessible to intangible considerations. The question 'Has the negro a religion?' cannot be answered at once, either affirmatively or negatively. It must first be made clear what is to be understood by religion. He has a confused mixture of vague wants and superstitious impulses. A system of computing time can hardly be predicated of such a people; but they have a kind of superficial calendar of the months, which they make to help regulate their agricultural operations. The negro undoubtedly possesses all the capacities for education and civilization to at least as great an extent as our primitive ancestors. The fact that the psychical and intellectual, as well as the physical, differences between particular races of men are really insignificant, is destined to be made plainer, the more the subject is impartially studied; and the efforts of certain men, learned in distinctions of types, to set up fixed marks of separation between them, will not succeed.—(*Pop. sc. monthly*, July.) J. W. P. [195

## *NOTES AND NEWS.*

The unexampled recent increase in the membership of the American association for the advancement of science, from a little over one thousand just before the Boston meeting of 1880, to nearly two thousand now, implies a considerable increase in its funds, and should imply direct participation by the association in the endowment of research, which its means have not hitherto permitted. No other way is now open for the association to advance science so securely.

We desire, therefore, to call the attention of the executive board of the association to the direct advantage which would certainly result in following the example of the British association by making an annual grant to the Naples zoölogical station, whose claims and advantages have already been so well stated in our columns by Miss Nunn and Dr. Whitman. The board would find no lack of applicants for the table thus secured, the cost of which would be four hundred dollars annually.

—Mr. George M. West of Escanaba, Mich., sends us a photograph of a hoe-shaped implement which is stated to have been made of native copper by hammering. The blade has a thin edge, and is said to be nearly nine inches long, about three inches wide, and one-half inch thick at the back where it joins the

shank. The shank is an inch square at its union with the blade, six inches long, and half an inch square at its distal end. This implement was found in Brown County, Wis., and is, we believe, unique among the many copper objects found in North America, of which Wisconsin has yielded so large a proportion. While we have no reason to doubt the statement that this implement is made of native copper, we should rather have it placed in our hands for careful examination before committing ourselves as to its character and use. Should it prove to be all that the photograph suggests, we should like to give a description, with figures.

— In the first part of an article on 'Zoölogy at the Fisheries exhibition,' *Nature* of July 26 gives unstinted praise to the collections, public and private, exhibited by the United States, and admires the beauty of the marine objects shown by the Naples zoölogical station. Speaking of the collections shown by the U. S. fish-commission, it says, "It is not an exaggeration to say that this collection, both on account of the range and variety of its objects and the instructive way in which they have been disposed and treated by the American commissioner, Mr. Brown Goode, has been the admiration of all visitors."

— According to *Nature*, the Berlin academy of sciences has granted the following amounts from its Humboldt fund: 5,000 marks ($1,250) to Dr. Otto Finch, for working at the collection he made during his journey in Polynesia; 6,000 marks ($1,500) to Dr. Ed. Arning (Breslau), for researches on the leprosy epidemic in the Hawaiian Islands; the same amount to Dr. Paul Güssfeldt, to enable him to continue and extend his exploring tour in the Andes of Chili.

— The *Société industrielle de Mulhouse* has awarded its silver medal (*médaille d'argent hors concours*) to Mr. C. J. H. Woodbury of the Boston manufacturers' mutual fire-insurance company for his book, 'Fire protection of mills.'

— Dr. J. W. Mallet has resigned the professorship of chemistry in the University of Virginia.

## RECENT BOOKS AND PAMPHLETS.

**** Continuations and brief papers extracted from serial literature without repagination are not included in this list. Exceptions are made for annual reports of American institutions, newly established periodicals, and memoirs of considerable extent.*

**Adams,** C. Francis, jun. A college fetich: address before the Harvard chapter of the fraternity of the Phi Beta Kappa in Sander's theatre, Cambridge, June 28, 1883. Boston, *Lee & Shepard*, 1883. 38 p. 8°.

**Caspari,** H. Beiträge zur kenntniss des hautgewebes der cacteen. Halle, *Fausch & Grosse*, 1883. 53 p. 8°.

**Fletcher,** R. Human proportion in art and anthropometry. A lecture delivered at the National museum, Washington, D.C. Cambridge, *King*, 1883. 37 p., illustr. 8°.

**Greenwood,** *Major.* Aids to zoölogy and comparative anatomy. London, *Baillière*, 1883. 120 p. 12°.

**Hahn,** G. Der pilz-sammler, oder anleitung zur kenntniss der wichtigsten pilze Deutschlands und der angrenzenden länder. Gera, *Kanitz*, 1883. 9+87 p., 23 col. pl. 8°.

**Hale,** H The Iroquois book of rites. Philadelphia, *Brinton*, 1883. (Brinton's libr. aborig. Amer. lit., ii.) 222 p. 8°.

**Hann,** J. Handbuch der klimatologie. Stuttgart, *Engelhorn*, 1883. 10+764 p. 8°.

**Hawkins,** B. W. Comparative anatomy as applied to the purposes of the artists. Edited by George Wallis. London, *Winsor & Newton*, 1883. 90 p., illustr. 12°.

**Hellmann,** G. Repertorium der deutschen meteorologie. Leistungen der Deutschen in schriften, erfindungen, und beobachtungen auf dem gebiete der meteorologie und des erdmagnetismus von den ältesten zeiten bis zum schlusse des jahres 1881. Leipzig, *Engelmann*, 1883. 23+996 p., illustr. 8°.

**Hofmann,** J. Flora des Isargebietes von Wolfratshausen bis Deggendorf, enthaltend eine aufzählung und beschreibung der in diesem gebiete vorkommenden wildwachsenden und allgemein kultevierten gefässpflanzen. Landshut, *Krüll*, 1883. 64+377 p., 1 col. pl. 8°.

**Jahn,** H. Die electrolyse und ihre bedeutung für die theoretische und angewandte chemie. Wien, *Hölder*, 1883. 9+206 p. 8°.

**Kalischer,** S. Goethe als naturforscher und Herr du Bois-Reymond als sein kritiker. Eine antikritik. Berlin, *Hempel*, 1883. 90 p. 8°.

**Kingston,** W. H. G. Stories of the sagacity of animals. Cats and dogs. London, *Nelsons*, 1883. 162 p., illustr. 8°.

**Leon,** Néstor Ponce de. Diccionario tecnológico, Inglés-Español y Español-Inglés, de los terminos y frases usados en las ciencias aplicadas, artes industriales, bellas artes, mecánica, maquinaria, minas, metalurgia, agricultura, comercio, navegacion, manufacturas, arquitectura, ingenieria civil y militar, marina, arte militar, ferro-carriles, telégrafas, etc. pt. i., ii. N.Y., *de Leon*, 1883. 48, 49+96 p. 4°.

**Mann,** F. Abhandlungen aus dem gebiete der mathematik. Würzburg, *Stahel*, 1883. 5+43 p. 8°.

**Maudsley,** H. Body and will: being an essay concerning will in its metaphysical, physiological, and pathological aspects. London, *Paul*, 1883. 330 p. 8°.

**Meyer,** A. Das chlorophyllkorn in chemischer, morphologischer, und biologischer beziehung. Ein beitrag zur kenntniss des chlorophyllkornes der angiospermen und seiner metamorphosen. Leipzig, *Felix*, 1883. 7+91 p., 3 col. pl. 4°.

**Miller-Hauenfels,** A. von. Theoretische meteorologie. Ein versuch, die erscheinungen des luftkreises auf grundgesetze zurückzuführen. Mit einer begleitschreiben von Dr J. Hann. Wien, *Spielhagen*, 1883. 8+129 p., illustr. 8°.

**Nichols,** W. R. Water-supply considered mainly from a chemical and sanitary stand-point. N.Y., *Wiley*, 1883. 6+232 p., illustr. 8°.

**Oborny,** A. Flora von Mähren und Österreich-Schlesien, enthaltend die wildwachsenden, verwilderten und häufig angebauten gefässpflanzen. 1 theil: Die gefässkryptogamen, gymnospermen und monocotyledonen. Brünn, *Winiker*, 1882. 268 p. 8°.

**Pfaff,** F. Die entwickelung der welt auf atomistischer grundlage. Ein beitrag zur charakteristik des materialismus. Heidelberg, *Winter*, 1883. 10+241 p., illustr. 8°.

**Salomon,** C. Nomenclator der gefässkryptogamen oder alphabetische aufzählung der gattungen und arten der bekannten gefässkryptogamen mit ihren synonymen und ihrer geographischen verbreitung. Leipzig, *Voigt*, 1883. 10+385 p. 8°.

**Schell,** A. Die methoden der tachymetrie bei anwendung eines ocular-filar-schrauben-mikrometers. Wien, *Seidel*, 1883. 5+49 p., illustr. 8°.

**Seebohm,** F. The English village community, examined in its relations to the manorial and tribal systems, and to the common or open field system of husbandry. London, *Longmans*, 1883. 464 p., 13 maps and pl. 8°.

**Sterne,** C. Sommerblumen. Mit 77 abbildungen in farbendruck nach der natur gemalt von Jenny Schermaul und mit vielen holzschnitten. lief. i., ii. Leipzig, *Freytag*, 1883. 64 p. 8°.

**Suess,** E. Das antlitz der erde. Mit abbildungen und kartenskizzen. abth. i. Leipzig, *Freytag*, 1883. 310 p. 8°.

**Thompson,** Silvanus P. Dynamo-electric machinery: lectures, reprinted from the Journal of the society of arts, with an introduction by Frank L. Pope. N.Y., *Van Nostrand*, 1883. 218 p., illustr. 24°.

**Villicus,** F. Zur geschichte der rechenkunst mit besonderer rücksicht auf Deutschland und Oesterreich. Wien, *Pichler*, 1883. 6+100 p., illustr. 8°.

**Wilson,** E. The recent archaic discovery of ancient Egyptian mummies at Thebes: a lecture. London, *Paul*, 1883. 8°.

**Wood,** H. A season among the wild flowers. London, *Sonnenschein*, 1883. 256 p., illustr. 8°.

**Zincken,** C. F. Die geologischen horizonte der fossilen kohlen, oder die fundorte der geologisch bestimmten fossilen kohlen, nach deren relativem alter zusammengestellt. Leipzig, *Senf*, 1883. 7+90 p. 8°.

**Zwackh-Holzhausen,** W. von. Die lichenen Heidelbergs nach dem systeme und den bestimmungen Dr. W. Nylanders. Heidelberg, *Weiss*, 1883. 4+84 p. 8°.